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Research for Sustainability





FENG Research Bulletin
Editorial Team

“Since UNIMAS is the largest university in the state of Sarawak, it has a unique responsibility of maintaining good quality teaching in parallel to conducting research for sustainability.”

Research is at the heart of knowledge creation. An academic institution can only deliver the best quality education to its students when its Faculty is also engaged in cutting edge research. This has been the motivation and spirit at the Faculty of Engineering since its inception about 21 years from now.

Since UNIMAS is the largest university in the state of Sarawak, it has a unique responsibility of maintaining good quality teaching in parallel to conducting research for sustainability. The FENG Research Bulletin, which has entered into its 7th year of publication, is conceived as a window to portray this to the outside world and to the scientific community in a specific manner. The editorial team has worked in a coordinated manner to gather relevant information and to present this in a readable and attractive manner.

The Editors are thankful to all the Faculty members who have contributed through their research activities and also to the Faculty administration which has supported the publication of this bulletin. A special thanks to the readers who spare time to read and further propagate the information provided in this bulletin.

Prof. Dr Amir Azam Khan
Editor FENG Research Bulletin

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Editorial Policy

The FENG Research Bulletin is a publication of the Faculty of Engineering, Universiti Malaysia Sarawak (UNIMAS). It publishes current information on Research Activities, Research Publications, Research Findings, Recent Research Equipment, Conferences, Seminars and Research Students of the Faculty of Engineering, UNIMAS.

MESSAGES

- 1 Editorial Note
- 2 Contents
- 4 Messages

RESEARCH

5 Feature Article

Dynamic Young's Modulus Measurement of Treated and Post-Treated Tropical Wood Polymer Composites (WPC).

13 Research Grants

18 Extended Abstracts from Selected Projects

An investigation on Agrowaste-based Selective Catalytic Reduction (SCR) Catalyst in a Denitrification of Biomass-Combustion Flue Gas.

Design and Efficiency Testing of a New Approach to Water Draining System in Slope.

Investigation of the Required Parameters for Clubfoot Treatment Based on Non-Invasive Medical Approach.

Theoretical Formulation of Interfacial Layer Growth between High-k and Germanium Surface.

Development of Durable Eco-friendly Modified Multi component Binder (MMCB) Containing Ground Spent Fluidized Catalytic Cracking Catalyst (GSF3C).

23 Research Publications





32

MoU with CMS Pavement Tech

RESEARCH NEWS

26

Materials Characterization Workshop Series 1: XRD, DSC, DMTA, SEM and EDX

Faculty of Engineering Seminar Series

Design and Fabrication of Controlled Atmosphere Glove Box at the Department of Mechanical and Manufacturing Engineering

Technical Visit to Bau Palm Oil Mill Sdn Bhd and Stenggang Oil Palm Plantation Sdn Bhd

UNIMAS Wins 1 Diamond, 4 Gold Medals and One Bronze at the 2014 British Invention Show

Faculty of Engineering Captures Best Poster Award and a Bronze Medal at The National Geofest 2014

13th IAHR/IWA International Conference on Urban Drainage (ICUD2014)

Team from Mechanical and Manufacturing Engineering won Excellent Paper Award at iCAAA 2014, Krabi, Thailand

Research Visit to other Universities and Industries

Post Graduate Proposal Defence Organized at the Faculty of Engineering

Recent Research Facilities at the Faculty of Engineering

Collaboration with other Universities/ Organisations

Talks and Seminars

STUDENTS

34 Students' Best Papers

Synthesis and Characterization of Organically Modified Ceramics through Sol-Gel Process

Road Subsurface as Component of On-site Detention (OSD) Urban Drainage System

Utility Function in Broadband Wireless Network

36 Student News

Colloquium Curtin-UNIMAS 2014

38 Research Students

47 Research Contacts



36

Colloquium 2014 Curtin-UNIMAS 23rd April 2014

MESSAGE FROM THE DEAN

The Faculty of Engineering has moved a long way forward over the last few years. The Faculty members have a desire to conduct high quality research and are supported by the Faculty and University by all means in this respect. The research publications and research grants earned from Government and private sector have also seen an upward trend. Since 2009 the Faculty started publishing online the UNIMAS e Journal of Civil Engineering (UeJCE) which has entered into its 6th year of publication. The present year has seen the start of a second online journal from Faculty of Engineering, the Journal of Applied Science and Process Engineering (JASPE).

The FENG Research Bulletin is a publication which exists both in online and hard format. It provides information about all research activities being carried out at the Faculty during the current year, the present bulletin being the 7th volume in its series. I would like to congratulate all the Faculty staff for their untiring effort and motivation to excel in research. My appreciation also goes to the editorial committee members of FENG Research Bulletin. They have equally contributed in their academic and research activities as well as in gathering information for publishing this bulletin. This has opened a window for others to see what research achievement our Faculty has made over the years.

Assoc. Prof. Dr. Al-Khalid Bin Hj Othman
Dean, Faculty of Engineering, UNIMAS



MESSAGE FROM THE DEPUTY DEAN

The Faculty of Engineering is committed to keep research and development as its priority. The motto "Research for sustainability" reflects the endeavours put in place by the scientists and researchers of this Faculty to bring future technology to the doorstep of the community. Only when the research affects and improves the everyday life of the human community, then it can be considered as sustainable. All elements within the Faculty are geared together to make it achievable.

The FENG Research Bulletin has regularly been published by the Faculty of Engineering during the past few years, the present volume being the 7th volume in this series. An important effort has been put into this volume in order to make it representative of the research and development strides our Faculty has taken over the past years.

I would sincerely like to congratulate the Faculty members who were involved in research activities, developing new projects, supervising research, securing grants, organizing conferences, delivering keynote talks to International Conferences and publishing their research in top level journals. My warmest accolades also go to the Editorial committee of FENG Research Bulletin who have put a tremendous effort in making this research visible to the world.

Dr. Hushairi Zen
Deputy Dean (Postgraduate & Research),
Faculty of Engineering, UNIMAS



FEATURE ARTICLE

Dynamic Young's Modulus Measurement of Treated and Post-Treated Tropical Wood Polymer Composites (WPC)

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Abstract

By means of dynamic mechanical thermal analysis (DMTA), selected tropical wood species, namely *Eugenia* spp., *Artocarpus rigidus*, *Artocarpus elasticus*, *Koompassia malaccensis*, and *Xylopia* spp. have been characterized. The woods were treated with sodium meta-periodate to convert them into wood polymer composites (WPC). After two weeks the WPC were chemically treated with phenylhydrazine to convert them into secondary wood polymer composites, also called post-treated WPC (PTWPC). The chemical treatment and post-treatment are successful in improving the mechanical properties of the final product. The storage modulus (E') was measured using dynamic mechanical thermal analysis (DMTA), and the dynamic Young's modulus (E_d) was calculated using free-free vibrational testing. The results reveal that the elastic properties i.e. stiffness (E_d) and storage modulus (E') of the composite were dependent on the type of wood species. The E' of WPC and PTWPC were much higher than raw wood, whereas the glass transition temperatures (T_g) of WPC and PTWPC were much lower than those of raw wood. Free-free vibration testing provided rapid information about the quality of the composite material, such as the stiffness of the PTWPC compared to the respective WPC and raw woods. The WPC and PTWPC were characterized using Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). FTIR analysis indicate that the absorption band of raw wood at 1635 cm^{-1} was due to carbonyl stretching, whereas WPC and PTWPC showed increased absorption bands near 1718 cm^{-1} and 1604 cm^{-1} , respectively.

Keywords: Tropical Wood; Wood polymer composites; Post-treatment; Storage modulus; Elastic Properties; Stiffness

1. Introduction

New materials in the field of wood polymer composites with their new ranges of applications represent an important basis in order to fulfill the need for creating sustainable materials from less-useful wood. Because of their low density, good mechanical performance, unlimited availability, and problem-free disposal, softwoods offer a real alternative to the well-known hardwoods. Softwood specific mechanical properties are inferior compared with hardwood. The impregnation of wood with polymers results in composite materials with enhanced strength properties, dimensional stability, and resistance to bio-deterioration (Siau et al. 1965; Langwig et al. 1968; Calleton et al. 1970). Chemical coupling agents usually act as a bridge to link wood cell walls together and improve interfacial bonding strength in WPC (Woodhams et al. 1984; Dalvag et al. 1985). Chemical agents (such as phenyl hydrazine and sodium meta-periodate) can create new structures in the WPC that influence morphology, crystallization, mechanical, thermal, biological, and other properties of WPC and PTWPC (Quillin et al. 1993; Collier et al. 1995).

Studies of the dynamic properties of wood-polymer composites have shown that the storage moduli are much higher than can be accounted for from the quantity of impregnated polymer present. Siau (1968) and Moore (1981) attributed the high modulus to the interaction between wood cell wall components

and polymer. Durability of wood is directly related to its mechanical and thermal properties, which at the macro level are related to the viscoelastic properties of the wood components (polymers) (Holmberg et al. 1999).

Dynamic mechanical analysis (DMA) is a powerful technique to investigate thermal and mechanical properties of polymers. DMA permits determination of the viscoelastic behavior of wood polymers and provides valuable insights into the relationship among structure, morphology, and properties of wood polymers and their composites (Manchado and Arroyo 2000). It is understood that the viscoelastic behavior of wood depends on factors such as response of the amorphous polymers to changes in moisture content and temperature (Salmen 1984) and the response of the cellular structure to mechanical force. Dynamic mechanical analysis measures the modulus and damping properties of materials as the materials are deformed under periodic stress. The vibration technique is among the non-destructive testing (NDT) methods that are considered important in the timber industry (Halabe et al. 1995). This technique is an alternative for measuring the elastic properties and energy dissipation of wood. The method involves three types of vibration, namely bending (flexural), longitudinal (axial), and torsion, which are determined by the nature of vibration (Hearmon 1975; Bodig and Jayne 1982). Among the three types of vibration methods, the flexural vibration method is the most popular, since it is easiest to excite and detect the vibrations under investigation.

The dynamic mechanical characteristics of wood polymer composites (WPC) and post-treated wood polymer composites (PTWPC) are related to the properties of the components, the morphology of the system, and the nature of the interface between the layered cell walls and amorphous polymers such as lignin and hemicelluloses. Thus dynamic measurements can effectively be used to investigate these compatibilities and their impact on WPC and PTWPC properties. The glass transition temperature, T_g , can be defined as the temperature where: (1) the loss tangent ($\tan \delta$) is maximum; (2) the loss modulus (E'') is maximum, and (3) the inflexion points correspond to a significant drop in the storage modulus (E') (Nielsen 1974). The primary goal of the current study was to investigate the strength and stiffness of WPC and PTWPC. Softwoods are used to a great extent for the interior and domestic application. For these applications the strength and stiffness have to satisfy the requirement of low temperatures of about -100°C up to temperatures of about 60°C . For establishing such temperature-dependent material data, the DMTA is excellently suitable. In this study, Sodium meta-periodate (SMP) and phenyl hydrazine were used to prepare WPC and PTWPC. The dynamic storage modulus E' and $\tan \delta$ were compared with those of the raw wood. These studies also investigated the interaction between the impregnated polymer and the wood cell wall components.

2. Materials and methods

Five wood species were chosen for this study, among them, *Artocarpus elasticus*, *Artocarpus rigidus*, *Koompassia malaccensis*, and *Eugenia* spp. are softwoods, while *Xylopi*a spp. is hardwood. These tree species were chosen because of their fast growing nature and the fact that they are easily grown in the tropics. Chemicals used to treat the wood were H_2SO_4 , NaIO_4 , and phenylhydrazine (Merck, Germany). H_2SO_4 was used as a catalyst to increase the reaction rate by its addition during specimen preparation.

Specimen Preparations

Five trees were felled, and each tree was cut into three bolts of 1.2 m long. In this work only one tree was used for each species, and the within-species variation was not studied. Only the heartwood was used. Each bolt was quarter-sawn to produce planks of 4 cm thickness and subsequently conditioned to air-dryness in a room with relative humidity of 60% and ambient temperature of around 25°C for one month prior to testing. The planks were ripped and machined to 340mm(L)x20mm(T)x10mm(R) for free-free vibration test and 10mm(L)x2mm(R)x7.5mm(T) specimens for dynamic mechanical thermal analysis. Only 10 replicates were used. Raw wood specimens were treated with the oxidizing agent sodium meta-periodate using an autoclave for 2 hours in order to convert them into wood-polymer composites. The oxidizing agent sodium meta-periodate penetrated into the samples and reacted with the cellulose. The temperature and pressure used were 120°C and 85 kPa, respectively. No post curing was done. The penetration of *Artocarpus elasticus*, *Artocarpus rigidus*, *Koompassia malaccensis*, *Eugenia* spp., and *Xylopi*a spp. were 32%, 21.15%, 26%, 26.75, and 23%, respectively. Manufactured WPC was impregnated with phenyl hydrazine using a vacuum chamber at 25°C and 60cm Hg for 4 hours. These conditions are suitable for commercially sized samples.

Dynamic Young's Modulus Measurement

Dynamical mechanical thermal analysis (DMTA) was applied to study the effect of temperature on the storage modulus ($\log E'$) and loss tangent ($\tan \delta$) of the woods, WPC, and PTWPC. With DMTA, which is a mechanical test, molecules in woods interact with mechanical stress. Normally all molecular relaxation processes are detected using this technique. A Perkin Elmer dynamic mechanical thermal analyzer (PE-DMTA) was used at 10 Hz frequency, x4 strains, and 2°C min^{-1} temperature rise. The rectangular specimens with moisture content around 15% were tested using a dual-cantilever bending mode on a standard bending head. The chamber surrounding the specimen at 65%RH was cooled by liquid nitrogen, and the system provided a simple thermal scan at 2°C min^{-1} with various temperatures ranging from -100 to 200°C . The T_g was determined from the graph of $\tan \delta$ versus T .

Determination of E_d was carried out using the free-free flexural vibration testing system as shown in Fig. 1. The specimen was held with AA thread according to the first mode of vibration. The specimen with an iron plate bonded at one end was set facing the driver of the electromagnet, and a microphone was placed at the centre below the specimen. The frequency was varied in order to achieve a resonant or natural frequency. The E_d was calculated from the resonant frequency by using the following equation,

$$E' = \frac{4\pi^2 f^2 l^4 A \rho}{I(m_n)^4} \quad (1)$$

where $I = bd^3/12$, d is beam depth, b is beam width, l is beam length, f is natural frequency of the specimen, ρ is density, A is cross sectional area, and $n=1$ is the first mode of vibration, where $m_1=4.730$.

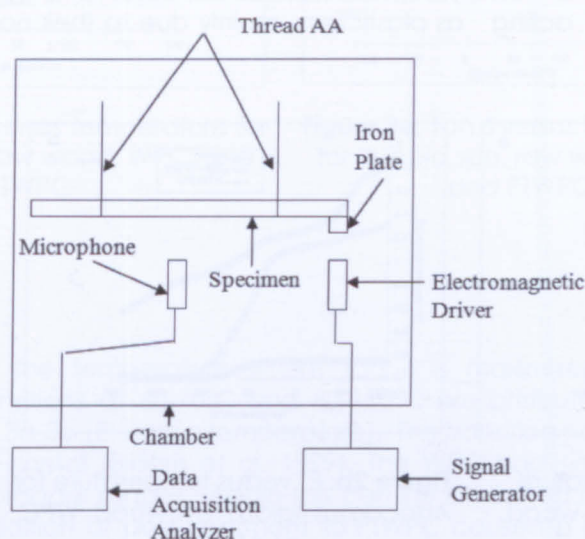


Figure 1. Free-free flexural vibration testing system

Microstructural Analysis

The infrared spectra of the raw and treated wood specimens were recorded on a Shimadzu Fourier Transform Infrared Spectroscopy (FTIR) 81001 Spectrophotometer. The transmittance range of scan was 370 to 4000 cm^{-1} . The interfacial bonding between the cellulose and sodium meta-periodate were examined using a Scanning Electron Microscope (JSM-6701F) supplied by the JEOL Company Limited, Japan. The specimens were first fixed with Karnovsky's fixative and then taken through a graded alcohol dehydration series. Once dehydrated, the specimen was coated with a thin layer of gold before being viewed on the SEM.

3. Results and Discussion

Dynamic Young's Modulus Measurement

The viscoelastic behaviour of the wood and their composites was studied by DMTA. Figure 2a-e shows the viscoelastic properties of the resulting raw wood, WPC, and PTWPC. The scales in the figures are not similar, and huge variation occurred due to the nature of the wood. Nevertheless the pattern displayed by

the raw, WPC, and PTWPC softwood showed a very similar trend. One can see that for softwood the E' of the WPC and PTWPC was improved considerably over that of the raw wood. For all softwoods a temperature dependence was significant, involving a steep drop above 50°C. The post-treatment samples (PTWPC) showed 2 transitions, i.e. at -50°C and 100°C, because sodium meta-periodate yields a transition at 100°C whereas the post-treatment with phenyl hydrazine yields a second transition at -50°C, which occurs earlier compared to WPC, i.e. only at 100°C due to sodium meta-periodate only. This explains why the increase in E' values throughout the whole temperature range for PTWPC was much less as compared with WPC.

For *Xylopi* spp. (hardwood) the improvement was, however, more obvious for the PTWPC than the WPC (Fig. 2e). This indicates that interfacial bonding strength of WPC and PTWPC increased with increase of storage modulus E' at high retention level of polymer grafting compared with the findings of other researchers (Lu et al. 2002). The cellulose in *Xylopi* spp. (i.e. hardwood) is not easily oxidized with sodium meta-periodate, yielding poor inter-phase interaction with the hydrophobic polymer matrix. Upon post-treatment with phenylhydrazine the hydrophilic hydroxyl groups filled all the voids with hydrophobic polymer matrix and yielded higher E' value compared with WPC and raw wood. Surprisingly, upon post-treatment with phenyl hydrazine the E' increased three times from that of the raw wood. These higher E' values for PTWPC, compared to those reported by others (Yap et al. 1991), reflect cross-linking or chain scission (increase in crystallinity) caused by the impregnated phenylhydrazine. In general the E' values increased with the treatment and post-treatment but eventually decreased to the same value as raw wood at 200°C.

Figure 3a-e shows that raw wood had higher $\tan \delta$ values than WPC and PTWPC (as seen in Fig. 3a and 3e). Loss tangent is related to the loss of energy, i.e. to viscous behavior (irreversible deformation). The lower $\tan \delta$ value in WPC and PTWPC implies higher elastic recovery, which can probably be attributed to higher polymer content caused by the cross-linking resulting from the treatment. The α -transitions (100-150°C) were more prominent in the $\tan \delta$ versus temperature scans. PTWPC samples were highly different from the WPC and raw wood because of their less hydrophilic nature. This observation indicates that the impregnated polymers were effectively acting as plasticizers, mainly due to their non-polar nature and relatively high molecular weight.

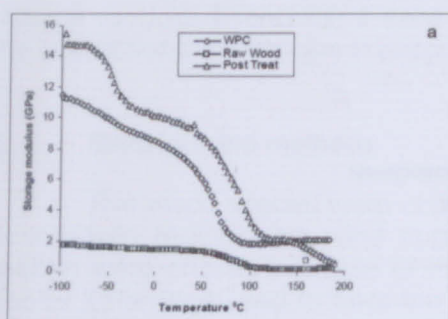


Figure 2a. E' versus temperature for *Artocarpus elasticus* raw wood, WPC, and PTWPC

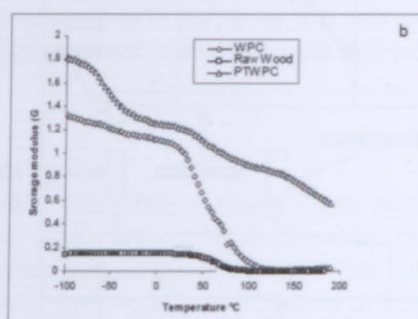


Figure 2b. E' versus temperature for *Artocarpus rigidus* raw wood, WPC, and PTWPC

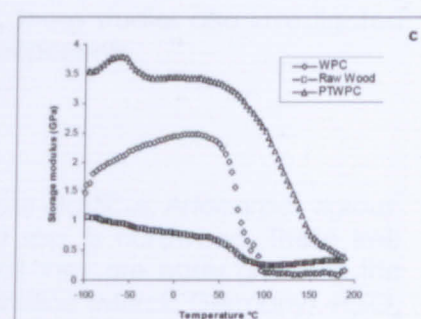


Figure 2c. E' versus temperature for *Koompasia malacennis* raw wood, WPC, and PTWPC

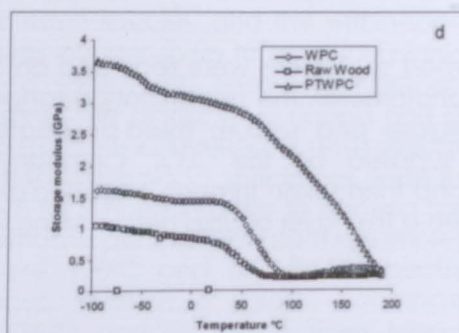


Figure 2d. E' versus temperature for *Eugennia* spp. raw wood, WPC, and PTWPC

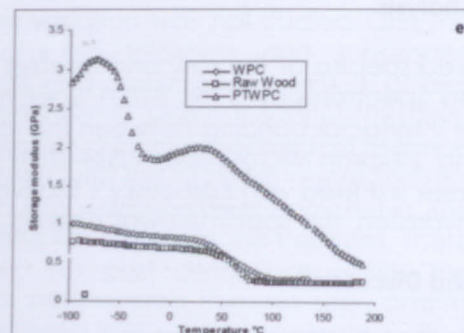


Figure 2e. E' versus temperature for *Xylopi* spp. raw wood, WPC, and PTWPC

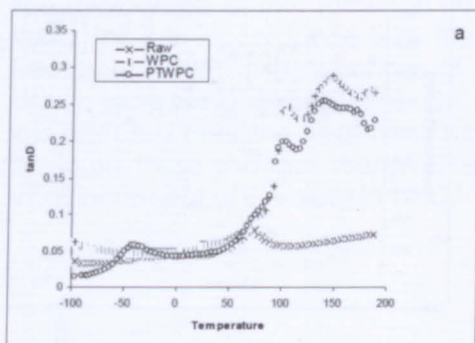


Figure 3a. Tan δ versus temperature for *Artocarpus elasticus* raw wood, WPC, and PTWPC

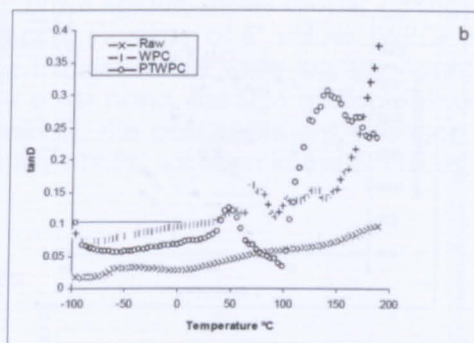


Figure 3b. Tan δ versus temperature for *Artocarpus rigidus* raw wood, WPC, and PTWPC

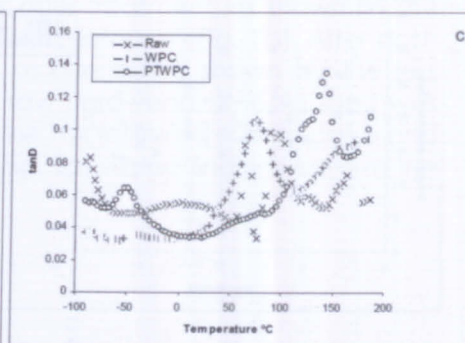


Figure 3c. Tan δ versus temperature for *Koompasia malacennis* raw wood, WPC, and PTWPC

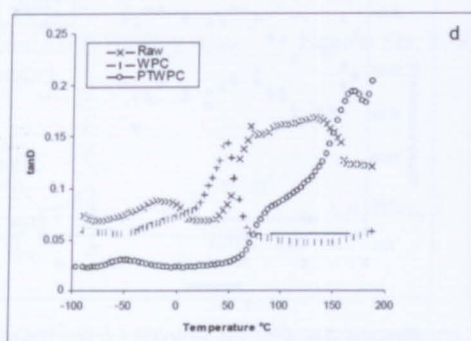


Figure 3d. Tan δ versus temperature for *Eugennia* spp. raw wood, WPC, and PTWPC

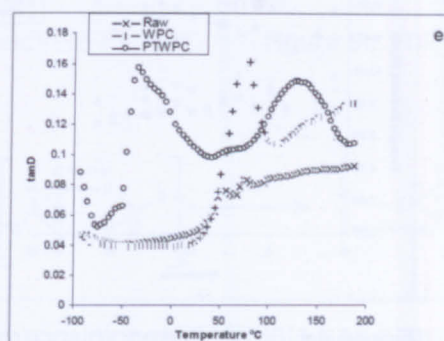


Figure 3e. Tan δ versus temperature for *Xylophia* spp. raw wood, WPC, and PTWPC

Assuming that the T_g is the temperature where $\tan \delta$ is maximized, the raw wood showed a transition near to -50°C . The transitions at $60\text{--}70^\circ\text{C}$ and $80\text{--}110^\circ\text{C}$ are attributed to a secondary transition, because this is not obvious in Fig. 3a–3e (E' versus temperature). This transition has been attributed to vibration and orientation motion within the crystal (Bikaris et al. 1999). The WPC had similar relaxation temperatures, but the relaxation occurred over broader ranges. Again this can be attributed to cross-linking and branching caused by the treatment. The addition of post-treatment to PTWPC caused a great shift in the relaxation to a higher temperature, indicating that the post-treatment increased the polymer chain mobility, thus increasing the secondary relaxation. This is interpreted as relaxation of the constrained molecules with reduced mobility close to crystallites (Bikaris et al. 1999). In general, the post-treatment caused a shift of the $\tan \delta$ to a higher temperature, indicating that there was an increase in the relaxation temperature. During the dynamic analysis, if the cell walls buckle, they exert a certain restorative force when amorphous polymers such as lignin and hemicelluloses are in a rubbery state.

The stiffness of the raw wood, WPC, and PTWPC from the free-free flexural vibration testing system is shown in Fig. 4(a–e). The treatments by sodium meta-periodate only slightly increased the Young's modulus, as seen in all species. The storage modulus was significantly affected by the treatment (see Fig. 2a–2e), but the elastic properties showed significant changes only in *Artocarpus elasticus*. Further treatment with phenylhydrazine enhanced the Young's modulus for all species.

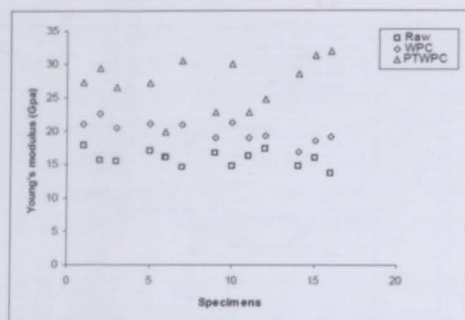


Figure 4a. *Ed* of *Artocarpus elasticus* raw wood, WPC, and PTWPC

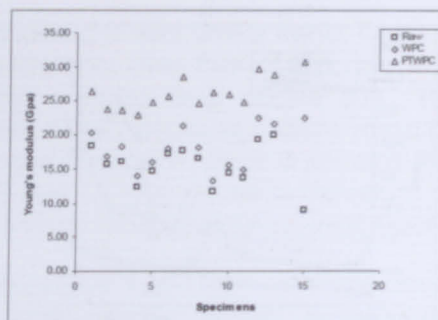


Figure 4b. *Ed* of *Artocarpus rigidus* raw wood, WPC, and PTWPC

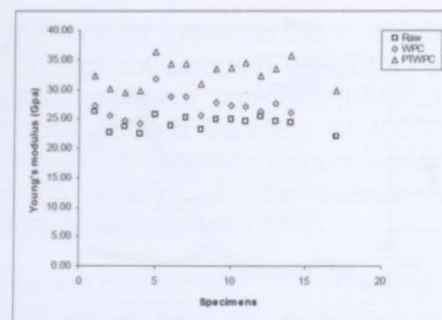


Figure 4c. *Ed* of *Koompasia malacensis* raw wood, WPC, and PTWPC

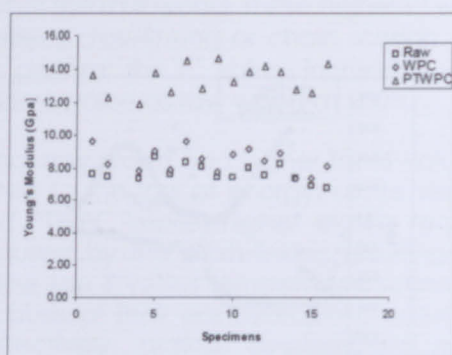


Figure 4d. *Ed* of *Eugennia* spp. raw wood, WPC, and PTWPC

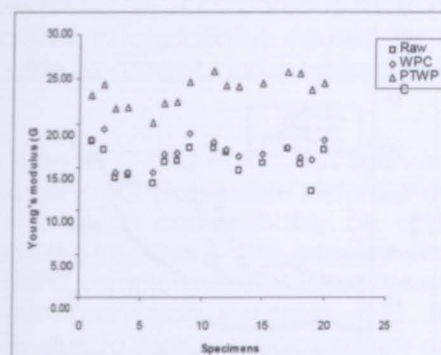


Figure 4e. *Ed* of *Xylopia* spp. raw wood, WPC, and PTWPC

Microstructural Analysis

Figure 5a-c shows the FTIR spectrum for the raw, WPC, and PTWPC for *Artocarpus elasticus*. The characterizations were performed on all species, but similar results were obtained. Thus only the results corresponding to *Artocarpus elasticus* are shown as a representative case. The reactions of sodium meta-periodate with cellulose in raw wood fiber at 120°C and 85 KPa pressure yielded the oxidized product, 2, 3-dialdehyde cellulose. Sodium meta-periodate not only impregnated the wood specimens but also reacted with hydroxyl groups of the cellulose and produced 2,3-dialdehyde cellulose. Dialdehyde cellulose filled up the void spaces within the wood structure and produced WPC. This was confirmed by the FTIR spectroscopic analysis of the raw and treated wood fiber (Fig.5a-b). The IR spectrum of the WPC clearly shows the characteristic band of an aldehyde group in the regions of 2906 cm^{-1} and 2850 cm^{-1} due to C-H stretching and in the region of 1734 cm^{-1} due to carbonyl stretching. The IR spectrum of the raw wood fiber (Fig. 5a) shows the absorption band near 1735 cm^{-1} . This absorption band is due to the carbonyl group of acetyl ester in hemicellulose and carbonyl aldehyde in lignin (Ismail et al. 2002). However, there was also an increased absorption band near 1718 cm^{-1} . This increased absorption band may be due to the carbonyl aldehyde of dialdehyde cellulose, which is formed by the oxidation of wood fibre as shown in Fig. 5b.

The formation of dialdehyde can be explained as due to three hydroxyl groups in the cellulose anhydroglucose unit. One is the primary hydroxyl group at C6 and other two are the secondary hydroxyl groups at C2 and C3. The primary hydroxyl group is more reactive than the secondary ones, so the cleavage of the anhydroglucose ring between carbons 2 and carbon 3 results in the formation of dialdehyde. The IR spectrum of the PTWPC (Fig. 5c) shows that the absorption band of 3431 cm^{-1} is the symmetric stretch of an NH_2 group in 2,3 diphenylhydrazo cellulose due to the carbonyl stretch at 1604 cm^{-1} . This clearly indicates that oxidize specimens were successfully impregnated with phenylhydrazine.

Figure 6 shows the chemical reaction between cellulose and sodium metaperiodate, producing dialdehyde cellulose. Upon post-treatment with phenylhydrazine the dialdehyde cellulose becomes 2,3-diphenylhydrazo cellulose. Figure 7a-b shows the SEM micrographs for the typical softwood and hardwood.

The micrograph of raw softwood (*Artocarpus rigidus*) shows drastic changes after treatment, as shown by the WPC. This is in accordance with the drastic increase of E' values (WPC) after treatment (Fig. 2b). After post-treatment (PTWPC) the changes of the microstructure were less significant, as also being shown by the less drastic increase of E' in PTWPC. On the other hand, the SEM micrograph of raw hardwood (*Xylopia* spp.) was less affected after the treatment. Surprisingly, the post-treatment changed the microstructure drastically, and obviously these changes strengthened the PTWPC, as seen in the E' values (Fig. 2e). These findings confirm the small increment of E' values in WPC.

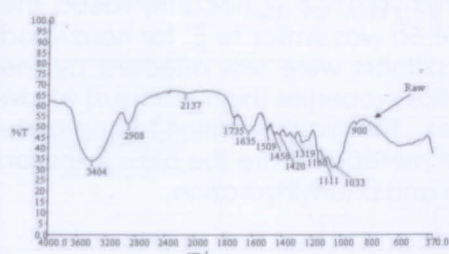


Figure 5a. FTIR spectrum for the raw wood

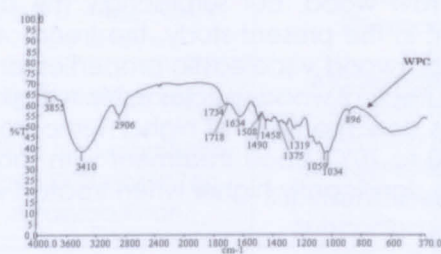


Figure 5b. FTIR spectrum for WPC

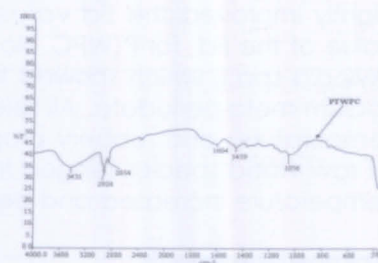


Figure 5c. FTIR spectrum for PTWPC

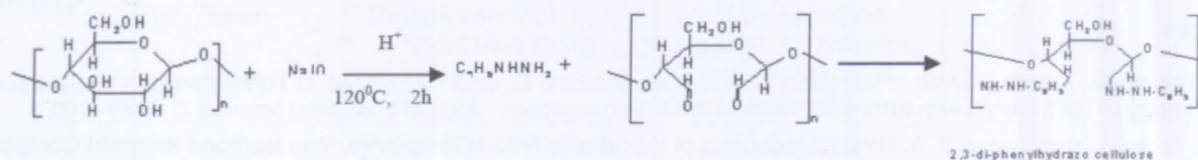


Figure 6. Oxidation of raw wood fiber specimens with sodium metaperiodate and phenylhydrazine

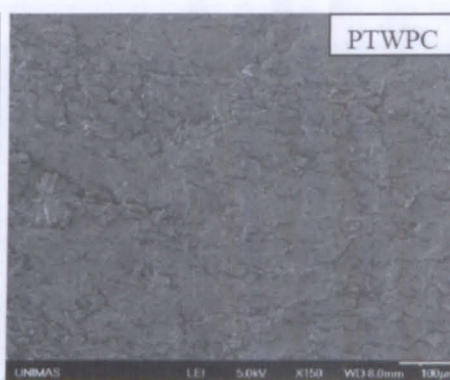
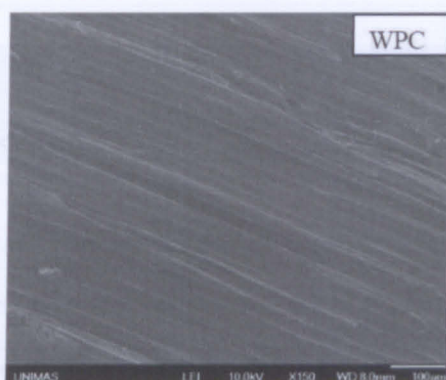
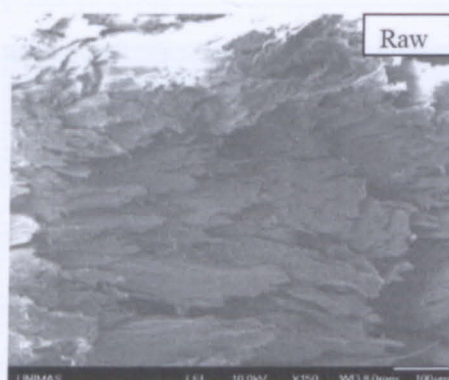


Figure 7a. SEM micrograph for typical softwood (*Artocarpus rigidus*)

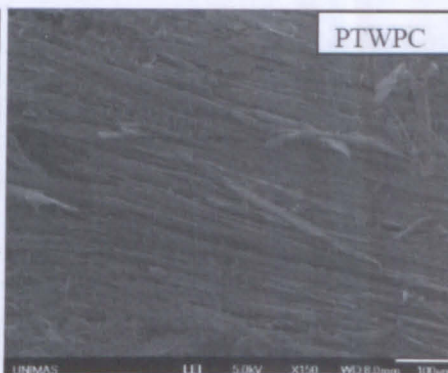
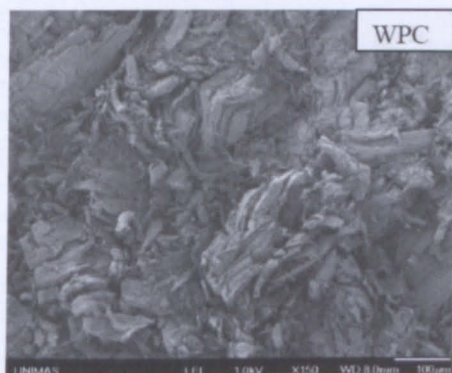


Figure 7b. SEM micrograph for typical hardwood (*Xylopia* spp.)

Conclusion

It can be concluded that the E' and E_g values for all the selected tropical wood species studied were strongly increased by the post-treatment. This means that E' and E_d values, depending on degree of polymerization, can be further improved with further post-treatments. E' values of all WPCs except *Xylopi* spp. (hardwood) were consistently larger than for raw wood, which means that sodium meta-periodate successfully converted raw wood to WPC in softwood. Upon further post-treatments with phenylhydrazine the E' values of all PTWPCs including *Xylopi* spp. (hardwood) were consistently larger than WPC, which means that with phenylhydrazine it was possible to successfully convert WPC to PTWPC. In general the sodium meta-periodate slightly improved the E_d values of raw wood, but surprisingly the phenylhydrazine significantly raised the value of the E_d for PTWPC. However, in the present study, the trend of the E_d was similar to E' for hardwood (*Xylopi* spp.), which showed that hardwood viscoelastic properties and stiffness were less affected by the sodium meta-periodate. All selected tropical wood species exhibited glass-like properties (high modulus) at low temperatures and rubbery properties (low modulus) at higher temperatures. The glass transition temperature of raw wood species ranged from 50 to 70°C. Upon treatment with sodium metaperiodate the glass transition temperature increased and became significantly higher when treated with and phenylhydrazine.

Acknowledgements

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RESEARCH GRANTS

Dana Principal Investigator (DPI)					
Grant No	Project Leader	Co-Researcher	Title	Duration (Month)	Budget (RM)
02(DPI19)955/ 2013(02)	Assoc Prof Dr Siti Noor Linda bt. Hj. Taib	Prof Dr Shenbaga Rajaratnam Kaniraj Jeyachandran, Ahmad Kamal b. Abd. Aziz, Ir. Lee Lin Jye	Investigation on Lateral of Piles in Sarawak Soft Riverbank	24	50,000
02(DPI23)999/ 2013(06)	Assoc Prof Dr Khairuddin Sanaullah	Dr. Lim Soh Fong Prof. Ir. Dr. Mohd Sobri Takriff, Dr Hushairi Zen, Afrasyab Khan	Modeling/CFD Validation of Direct Contact Condensation of Supersonic Steam with Subcooled water	24	50,000
F02(DPI25)1125/ 2014(01)	Assoc Prof Dr M. Shahidul Islam	Assoc Prof Dr Abdullah Yassin, Assoc Prof Dr Syed Tarmizi Syed Shazali, Lee Man Djun, Ting Ching Hung	Modelling Capacity Utilization of Water Treatment Plants for Achieving Sustainability in Manufacturing Industry: An Empirical Study in Sarawak, Malaysia	24	55,000
F02(DPI26)1126/ 2014(02)	Dr Hushairi Zen	Assoc Prof Dr Al-Khalid Othman, Prof Datuk Khairuddin Abd Hamid, Bello Olalekan	Cross Layer Scheduling and Resource Allocation in WiMAX	36	51,600

ERGS					
Grant No	Project Leader	Co-Researcher	Title	Duration (Month)	Budget (RM)
ERGS/TK01 (01)/1007/ 2013 (04)	Assoc Prof Dr Abdullah Bin Yassin	AP Dr Syed Termizi Syed Shazali, AP Dr M Shahidul Islam, Mohd Azrin Mohd Said	A Novel Method in Measuring Cutting Edge Temperature of End Mill Tool in High Speed Machining Using Infrared Radiation	36	132,000
ERGS/TK03 (01)/1008/ 2013 (05)	Dr Onni Suhaiza Binti Selaman	AP Dr Nasser Rostam Ashfar, AP Dr Siti Noor Linda Taib, Dr Darrien Mah Yau Seng, Dygku Salma Awg Ismail, Dr Magdelene Andrew Munot, Dr Ena Kartina Abdul Rahman (Insitut Teknologi Brunei)	Design and Efficiency Testing of a New Approach to Water Draining System in Slope	24	80,000
ERGS/TK03 (02)/1009/ 2013 (06)	Prof Md Abdul Mannan (Norazlina Bateni)	Prof Dr FJ Futuhea, Prof Dr Ngee Chee Khoon, AP Dr Resdiansyah Mansyur, Dr Darrien Mah Yau Seng, Dr Delsye Teo Ching Lee	Performance of Micro-detention Pond using Honeycomb Structure for Green Pavement in Housing Area	36	135,000

ERGS/TK04 (02)/1011/ 2013 (08)	Dr Norsuzailina Mohamed Sutan	Dato Ir Dr Mohd Saleh Jafar- UPM, Prof Dr Sinin Hamdan, Dr Zainal Abidin Taib, Dr Delsye Teo Ching Lee, Prof Dr Taufik Yup Yun Hin (UPM)	Developments of Durable Eco- Friendly Modified Multicomponent Binder (MMCB) Cement System Containing Ground Spent Fluidized Catalytic Cracking Unit (GSFCCU).	36	98,000
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FRGS 2014					
Grant No	Project Leader	Co-Researcher	Title	Duration (Month)	Budget (RM)
FRGS/TK04 (01)/972/ 2013 (13)	Dr Delsye Teo Ching Lee	Prof Dr Ng Chee Khoo, Prof Dr Md Abdul Mannan, Prof Dr Hilmi Mahmud (UM), Dr Norsuzailina Mohamad Sutan	Chloride Penetration and Time to Corrosion Initiation of Concrete Produced from Agricultural Waste	36	73,000
FRGS/TK01 (01)/973/ 2013 (14)	Assoc Prof Dr Syed Tarmizi Bin Syed Shazali	Prof Dr Wan Hashim Wan Ibrahim, AP Dr M Shahidul Islam, AP Dr Abdullah Yassin, AP Dr Al Khalid Othman, Saiful Bahari Mohd Yusoff, Ahmad Adzlan Fadzli Bin Khairi, Hishammuddin Afifi Huspi, Mohd Azrin Mohd Said	Modelling of Energy Extraction From Low Velocity Water Stream with Micro Hydro Turbine	36	128,000
FRGS/ICT02 (01)/997/ 2013 (38)	Dr Tay Kai Meng	Prof Dr Lim Chee Peng (USM), Dr Mah Yau Seng, Asrani Lit, Dr Delsye Teo Ching Leng	A Novel Theoretical Synthesis of Fuzzy Causal Modeling and Information Theory: Mathematical Extensions, Evaluations, and a Real World Application in Sarawak	36	68,900
FRGS/TK07 (01)/1055/ 2013 (01)	AP Dr Siti Noor Linda Taib	Dr Nursuzailina Mohamed Sutan, Ibrahim B Yakub, Ron Aldrino Chan@Ron Buking, Dr Norazzlina M.Sa'don, Prof Fauziah Bt Ahmad	Strength, Morphological and Chemical Characterizations of Pavement Subbase Modified by Chemical and Industrial Waste for Durable Road Construction.	36	75,000
FRGS/TK01 (01)/1059/ 2013 (05)	Dr Mohd Danial Bin Ibrahim	Dr Miyana Norifumu, Nabilah Ibrahim, Muhd Fadzli Ashari	Investigation of Non- Newtonian and Multiphase Laminar- Turbulent Flow Regime Rheology of Modified Nano-Macro Boundary Surfaces	24	96,850
FRGS/TK03 (01)/1063/ 2013 (09)	Ir Dr David Bong Boon Liang	Dr Tay Kai Meng, Prof Dr Ir Andrew Ragai Ak Henry Rigit, Dr Khoo Bee Ea	Tuning-Free Spatial Descriptor Model For Image Quality Perception	24	51,000

FRGS/TK04 (01)/1081/ 2013 (27)	Dr Nicholas Kuan Hoo Tien	Prof Dr Amir Azam Khan	An investigation of the analytical tensile model and mathematical impact response formula for the novel lightweight eco-friendly Pandanus atropaceus based composite.	36	74,500
FRGS/TK04 (02)/1082/ 2013 (28)	Dr Siti Kudnie Sahari	Dr Nursuzailina Mohamed Sutan, Prof Burhanudin Yeop Majlis, Dr Rohana Sapawi, Dr Ibrahim Ahmad, APDr Azrul Azlan b. Hamzah	Theoretical Formulation of Interfacial Layer Growth between High-k and Germanium Surface	24	81,000
FRGS/SG02 (01)/1085/ 2013 (31)	Prof Dr Sinin Hamdan	AP Dr Hasnizam Ab Wahid Prof Dr Ismail Jusoh	Sound Quality Assessment of Wood	36	112,000
FRGS/TK01 (01)/1136/ 2014 (03)	Dr Shahrol Mohamaddan	Annisa Binti Jamali , Siti Zawiah Bt Md Dawal, Ahmad Hata Rasit, Mohd Syahmi Bin Jamaludin, Noor Aliah Binti Abdul Majid	Investigation of the Required Parameters for Club Foot Treatment Based On Non-Invasive Medical Approach	24	91,400
FRGS/TK04 (02)/1138/ 2014 (05)	Ibrahim bin Yakub	Norsuzailina Binti Mohamed Sutan, Taufiq Yap Yun Hin, Khairul Anwar Bin Mohamad Said	An investigation on agrowaste- based Selective Catalytic Reduction (SCR) catalyst in a denitrification of biomass-combustion flue gas	36	126,200
FRGS/2/2014/ TK03/ UNIMAS/02/2	Dr Rohana Sapawi	Dr Siti Kudnie Sahari, Dayang Nur Salmi Dharmiza Awang Salleh, Dr Sohiful Anuar bin Zainol Murad (UMP)	Mathematical Modeling of Minimal Phase Nonlinearity CMOS Power Amplifier for Ultra Wideband Communication	24	121,200
FRGS/2/2014/ TK02/ UNIMAS/02/2	Gaddafi Bin Ismaili	Annisa Jamali, Dr Iskanda Openg (UiTM), Dr Alik Duju (Sarawak Forestry Corporation)	Establishment of actual strength group and utilization of modified version of Acacia mangium Timber of Sarawak.	24	100,000

RACE						
Grant No	Project Leader	Co-Researcher	Collaborative RU	Title	Duration (Month)	Budget (RM)
RACE/c(1)/ 1108/2014 (16)	Dr Norsuzailina Mohamed Sutan	Dato Ir Dr Mohd Saleh Jaafar (UPM), Dr Khamirul Amin Matori (UPM), Ibrahim Yakub (UNIMAS)	Dato Ir Dr Mohd Saleh Jaafar (UPM)	Characterizations and morphology of Tobermorite and Jennite like Calcium Silicate Hydrate (C-S-H) during hydration of Nano Pozzolanic Modified Binder (NPMB)	24	45,000

RACE/c(2)/ 1109/2014 (17)	Ir Dr David Bong Boon Liang	Prof Dr Nor Ashidi Mat Isa (USM), Dr Khoo Bee Ee (USM)	Prof Dr Nor Ashidi Mat Isa (USM), Dr Khoo Bee Ee (USM)	Blind-PSNR Model For No-Reference Image Quality Assessment	24	50,000
RACE/c(3)/ 1110/2014 (18)	Dr Tay Kai Meng	Prof Dr Lim Chee Peng (USM), Nicholas Kuan Hoo Tien (UNIMAS), Dyg Nur Salmi Dharmiza Awg Salleh (UNIMAS), Hazmi Hijazi Abdul (UNIMAS)	Prof Dr Lim Chee Peng (USM)	A novel Interval Type-2 Single- Input-Rule-Modules Connected Fuzzy Inference System: Theoretical Analysis, Extensions and Practical Applications	36	50,000

RAGS					
Grant No	Project Leader	Co-Researcher	Title	Duration (Month)	Budget (RM)
RAGS/TK01 (1)/1050/ 2013 (17)	Annisa binti Jamali	Prof. Dr Mohamad Omar Abdullah, Ervina Junaidi, Noor Aliah Bt Abdul Majid, Dr Helmy Bin Hazmi, Mohd Fareez Edzuan Bin Abdullah, Mohd Syahmi bin Jamaludin	Parametric Study on Rehabilitation Robot of Upper Limb Impairment for Domestic Setting	24	65,000
RAGS/TK02 (1)/1051/ 2013 (18)	Abdul Hafiz Abdul Karim	Dr Azham Zulkarnain, Muhammad Fadzli Ashari, Dr Shafrida Sahrani	Automated Sorting System with Image Processing for Colony Enumeration System	24	51,900
RAGS/TK04 (1)/1052/ 2013 (19)	Mohd Syahmi Jamaluddin	Prof Dr Amir Azam Khan Dr Azham Zulkarnain Noor Aliah Abdul Majid Mohd Fareez Edzuan Bin Abdullah, Anissa Jamali	Mechanical Properties of Novel Hot Press Glycidyl Methacrylate/ Sago Biomass Biocomposite	24	51,000

SGS					
Grant No	Project Leader	Co-Researcher	Title	Duration (Month)	Budget (RM)
02(S136)/ 1111/2014 (01)	Ngu Sze Song	Martin Anyi	Design and Control of Pick and Place Robot Arm for Roller Clamp Assembly	12	10,000
02(S137)/ 1112/2014 (02)	Ir Dr Ting Sim Nee	AP Dr Naser Rostam, AP Dr Azhaili Baharun	Value Engineering for Optimised Micro Hydro Green Energy Island Construction Contracts Solution for Interior Sarawak	12	10,000
02(S138)/ 1113/2014 (03)	Dr Idawati Ismail	Prof Dr Sinin Hamdan	Utilization of Industrial by products as binder in construction material by alkaline activation	12	10,000

02(S140)/ 1117/2014 (05)	Dr Shafrida Sahrani	Dr Kismet Ak Hong Ping	Numerical Technique for Solving Electromagnetics Scattering Problems in Moving Boundaries and Its Application to Nanoelectrics	12	9,986
F02(S147)/ 1127/2014 (12)	Dr Mah Yau Seng	Nor Azalina Rosli, Prof Dr Frederick Josep Putuhena	Creating Multi-Purpose Road Pavement	24	25,000
F02(S149)/ 1129/2014 (14)	Dr Charles Bong Hin Joo	Prof Ir Dr Frederick Josep Putuhena	Effect of Sediment Deposition Thickness on Incipient Motion in Rigid Boundary Channel	24	25,000
F02(S153)/ 1154/2014 (18)	Dr Nordiana Rajae	AP Dr Awang Ahmad Sallehin Awang Husaini, Dr Azham Zulkharnain	Design and Synthesis of DNA Sequences for Solving Problems with DNA Computing	36	25,000

PRGS

Grant No	Project Leader	Co-Researcher	Title	Duration (Month)	Budget (RM)
PRGS/TK01/ (01)1167/ 2014 (01)	Dr Shahrol Mohammad	Annisa Binti Jamali, Khairul Aidil Azlin Abd Rahman, Helmy Hazami, Mohd Syahmi Jamaludin, Noor Aliah Abdul Majid	Portable Intelligent Sorting Machine for Grading Malaysia Pepper	24	84,400

Top Down UNIMAS

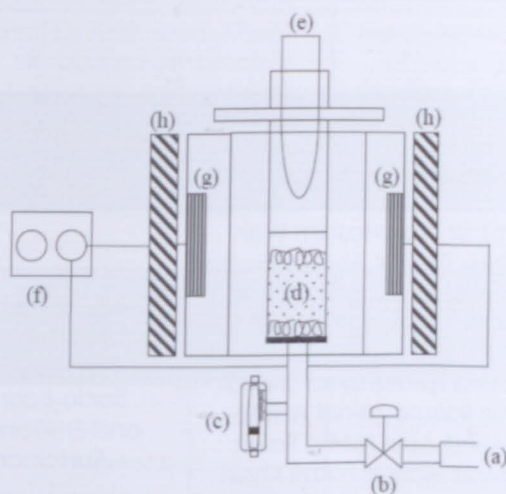
Grant No	Project Leader	Co-Researcher	Title	Duration (Month)	Budget (RM)
TD05	Prof Madya Dr M. Shahidul Islam	Prof Dr Wan Hashim Wan Ibrahim, Prof Dr Ahmad Hatta Rasit, PM Dr Shahren Ahmad Zaidi, Dr Muhammad Affandy Arip, AP Dr Abdullah Yasin, AP Dr Syed Tarmizi Syed Shazali, Ana Sakura Zainal Abidin, Mohd Azrin Mohd Said, Ahmad Adzlan Fadzli Khairi, Hishammudin Afifi Huspi, Ting Ching Hung, Lee Man Djun	Water Supply for Rural Community for Achieving Socio-Economic and Environmental Sustainability	5	50,000

EXTENDED ABSTRACTS FROM SELECTED PROJECTS

An Investigation on Agrowaste-based Selective Catalytic Reduction (SCR) Catalyst in a Denitrification of Biomass-Combustion Flue Gas

¹Ibrahim bin Yakub, Norsuzailina Mohamed Sutan, Taufiq-Yap Yun Hin, Khairul Anwar Mohd SaidEmail: ¹yibrahim@feng.unimas.my

NO_x, as a toxic byproduct released from biomass combustion to atmosphere, can be reduced using ammonia through one of the most effective methods called Selective Catalytic Reduction (SCR). Utilizing agrowaste such as palm kernel shell (PKS) and coconut shell (CS) as nano-catalyst supports instead of precious metals and coal can promote sustainability. However, the specific role of palm kernel and coconut shells has not yet been widely studied. Therefore, this project focuses on the performance of catalysts supported on AC derived from CS and PKS at the downstream of biomass-combustion flue gas treatment which is expected to contribute deeper understanding on the interaction between the supports and the catalysts. In order to achieve adequate and solid fundamental understanding, this project will study, investigate and determine the physical and the micro structural properties of the proposed agrowaste based SCR catalyst through nine (9) established and standardized tests: FESEM-EDX, TGA, FT-IR, TPDRO, XRD, BET, XPS, XRF and CHNSO. Then, the performance of the catalyst will be analyzed using Fixed-bed Catalytic Reactor as shown in Figure 1. The expected outcome is an extensive fundamental understanding of the system in terms of parametric data, microstructural properties and optimal denitrification conditions that will be published as Masters Thesis, journals and proceedings that will lead to a higher confidence in utilizing palm kernel and coconut shells as the catalyst to remove the toxic flue gas for a better green-energy investment.



(a) Exhaust pipe (b) Control valve (c) Flowmeter (d) Catalyst bed
(e) Gas analyzer & temperature sensor (f) Temperature control
(g) Heating elements (h) Protective casing

Figure 1. Schematic diagram of a Fixed-bed Catalytic Reactor

Design and Efficiency Testing of a New Approach to Water Draining System in Slope

Onni Suhaiza Selaman, Siti Noor Linda Taib, Nasser Rostam Afshar, Magdeline Munot, Ena Kartina Abdul Rahman (Faculty of Engineering, Institut Teknologi Brunei), Darrien Mah Yau Sen, & Dygku Salma Awg Ismail

Email: 'sosuhaiza@feng.unimas.my

Landslide occurrence in Malaysia is on the rise from year to year which has caused major public concerns due to the severe impacts on properties and lives. At one stage, it was reported that landslide had claimed economic loss of almost RM900 Mil in the year of 2003 (National Slope Master Plan, 2009). Rainfall is one of the triggering factors to the occurrence of landslide. With high rate of annual precipitation in Sarawak, the state has also been facing multiple events of landslides in areas such as along major trunk roads and in hilly areas. Hence, this exploratory research is initiated by UNIMAS and ITB researchers to investigate and explore various designs and modifications of sub-surface drainage system in slopes to reduce / avoid accumulation of infiltrated water. The research considers the current problem of the existing design and incorporates new materials to enhance the efficiency in draining water from slopes. Laboratory experimentation will be performed on models of drainage system in slope constructed using Model Tanks filled with soils in which pipes are embedded. It is expected that this exploratory research shall produce recommended design which has excellent efficiency in draining infiltrated water and with reduced sedimentation. Figure 1 shows testing set up designed for this research and Figure 2 presents data from preliminary test on different filter wrap made out of geotextile, used jeans and unbleached cotton. Result shows large water discharge from geotextile. However, sedimentation is less in the other two materials.

The research work is financially supported by Ministry of Education Malaysia ERGS/TK03(01)/1008/2013(05).



Figure 1. Test set up

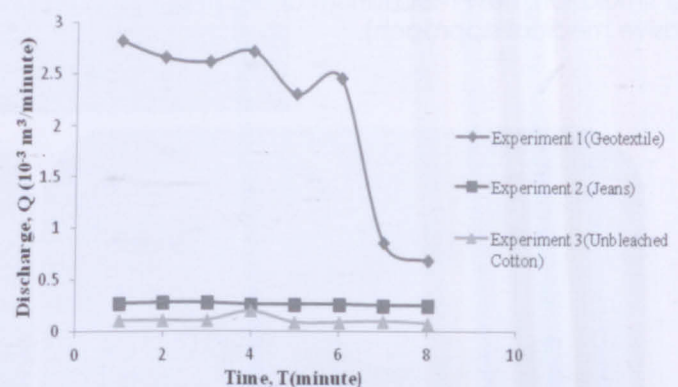


Figure 2. Discharge against time

Investigation of the Required Parameters for Clubfoot Treatment Based on Non-Invasive Medical Approach

¹Shahrol Mohamaddan, Annisa Jamali, Noor Aliah Abd Majid, Mohd Syahmi Jamaludin, Prof Dr Ahmad Hata Rasid (Faculty of Medicine and Health Sciences, UNIMAS) and Assoc. Prof Dr Siti Zawiyah Md Dawal (Faculty of Engineering, UM)

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"Clubfoot" (as shown in Figure 1) also known as Congenital Talipes Equino Varus (CTEV) is a common congenital deformity of the foot. The term talipes equinovarus is derived from Latin words: talus (ankle) and pes (foot); equines: "horse like" (the heel in plantar flexion) and varus: inverted and adducted. CTEV has an estimated birth prevalence of 1 per 1,000 live births. In Malaysia, clubfoot remains a significant problem and yields an unpredictable outcome due to late presentation for treatment and the ignorance of parents.

In general, the clubfoot treatment is divided into invasive and non-invasive medical approach. The invasive approach concerns with a typical foot surgery to correct the pathology which involve percutaneous tenotomy, posterior release, medical release, subtarsal release and complete tendon transfer. However, clubfoot surgery sometimes induces rigidity, weakness, early arthritis and pressure ulcer in the foot. The non-invasive approach does not requires surgery and widely preferred by patients. Nevertheless, the conventional non-invasive approach using the Ponsetti method (plaster casting) also induces problems such as skin dehydration, ulcers and blood circulation difficulties.

The objective of this project is to investigate the required parameters for clubfoot treatment. The patient's ankle or foot who using the Ponsetti method will be measured to understand how the plaster casting is applied and changed for the treatment. These include the degree of movement and rotation of the ankle or foot from the beginning until the end of the treatment. The required parameters from the measurement will be used to model and simulate the clubfoot treatment using the ergonomics software. Based on the ankle or foot modelling and simulation, new mechanism or technique can be proposed as an alternative to the Ponsetti method (non-invasive medical approach).

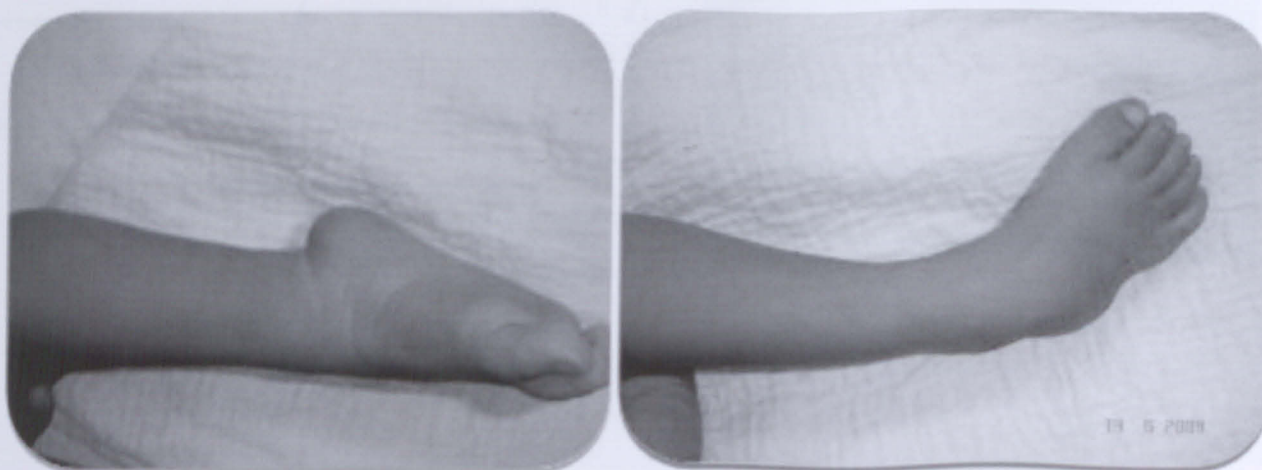


Figure 1. The "Clubfoot"

Theoretical Formulation of Interfacial Layer Growth between High-k and Germanium Surface

¹Siti Kudnie Sahari, Rohana Sapawi, Norsuzailina Mohamed Sutan, Azrul Azlan Bin Hamzah (UKM), Ibrahim Ahmad (UNITEN), Burhanuddin Yeop Majlis (UKM)

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Scaling down the Si Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) device can improve the performance of device reliability. However, downsizing the device has been confronted its fundamental limit associated with gate leakage currents that causes increased in power consumption and reduced device reliability. To overcome this problem, a new material with higher dielectric constant (high-k) which can allow increased in gate capacitance without associated leakage is introduced to replace SiO₂ as shown in Fig. 1. The introduction of high-k dielectric material re-opens the space for Germanium (Ge) as a candidate for high mobility channel due to its high bulk electron and hole mobilities than Silicon (Si). Past studies have shown the combination between high-k and Ge is indispensable. However, controlling the interfacial reaction high-k/ Ge interface and minimizing the interface defects are of major technological challenges. In addition, the formation of high quality high-k gate dielectric scalable to an oxide equivalent thickness (EOT) as thin as 0.5 nm or even lower is required. This study focuses on the growth kinetics of interfacial layer (IL) at high -k/Ge interface. In order to achieve adequate and solid understanding on the mechanism of IL growth, this study will investigate the kinetics of IL growth as a function of deposition temperature, deposition of time, and starting surface (HF-last or HCl-last). The IL growth will be compared with the theoretical models that can be found in literature describing the growth of thin SiO₂ layers, e.g., Deal-Grove, Mott-Cabrera, and Fehner-Mott that will fully utilize four (4) established and standardized measurement and characterization: SE, SEM, XPS, and FTIR. The expected outcome is an extensive fundamental understanding of the effect of temperature and starting surface to the IL growth at high-k/Ge will lead to the improvement in the Ge-MISFETs fabrication.

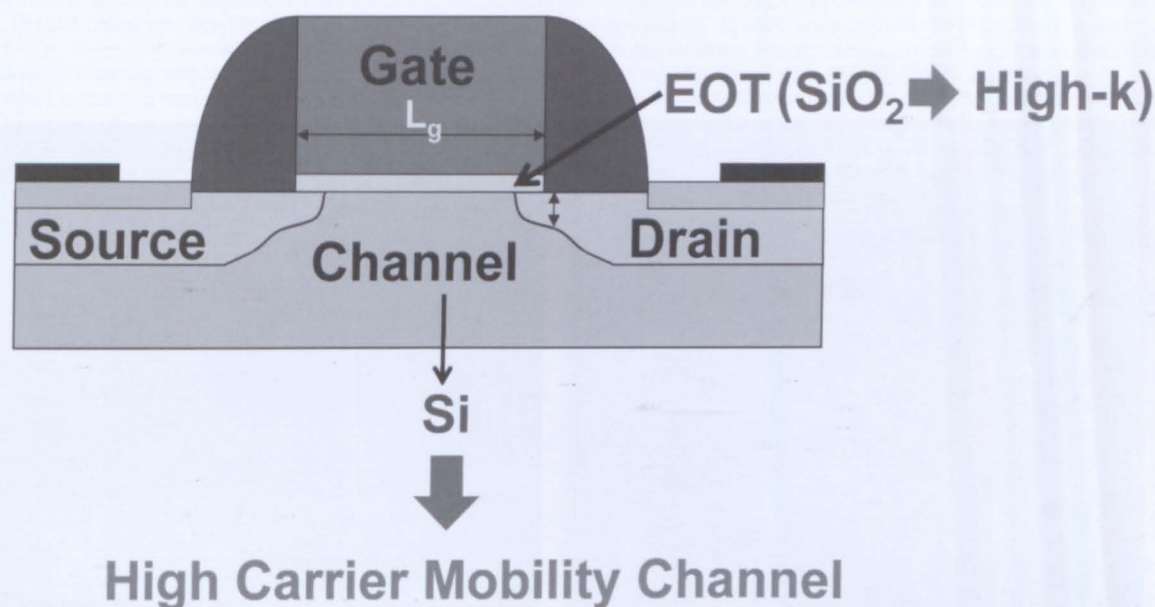


Figure 1. Metal Oxide Semiconductor Field Effect Transistor (MOSFET)

Development of Durable Eco-friendly Modified Multicomponent Binder (MMCB) Containing Ground Spent Fluidized Catalytic Cracking Catalyst (GSF₃C).

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Modified Multi Component Binder (MMCB) is a product composed of Ordinary Portland Cement (OPC) and finely ground mineral supplementary cementitious materials (SCM) such as industrial by-products and wastes that produce eco-friendly high performance concrete in terms of strength and durability. Approximately, 20,000 tonnes of Spent Fluidized Catalytic Cracking Catalyst (SF3C) are generated yearly from the fluid catalytic cracking process of petroleum refinery in South East Asia. Since the disposal of this waste material presents a complex challenge for many petroleum agencies worldwide, it is imperatively needful for it to be recycled or reused. This study focuses on utilizing Ground Spent Fluidized Catalytic Cracking Catalyst (GSF3C) in MMCB. A number of previous studies have examined the use of GSF3C but there is a lack of information on the overall durability performance of different types of GSF3C in MMCB that consists of different types of SCM. In order to achieve adequate and solid understanding on the behaviour of GSF3C in MMCB, this study will characterize, determine, estimate, identify and investigate the physical and the micro structural properties of the optimal level of the cement matrix system through five (5) distinct yet related phases that will fully utilize established and standardized methods and tests: SEM, EDX, TGA, FT-IR, XRD and Compressive Strength. The expected outcome of this exploratory work is an extensive understanding of how GSF3C affects MMCB in terms of physicochemical characteristic, durability factors and optimal level of replacements that will be published as a PhD/Master Thesis, journals and proceedings that will lead to not just a higher confidence in the use of GSFCC in concrete but also the beginning of more study on the application of this new non-conventional material in construction industry. Preliminary results in Figure 1 shows in the morphology of OPC and MMCB using SEM showing apparent evidence of pozzolanity in 10%MMCB.

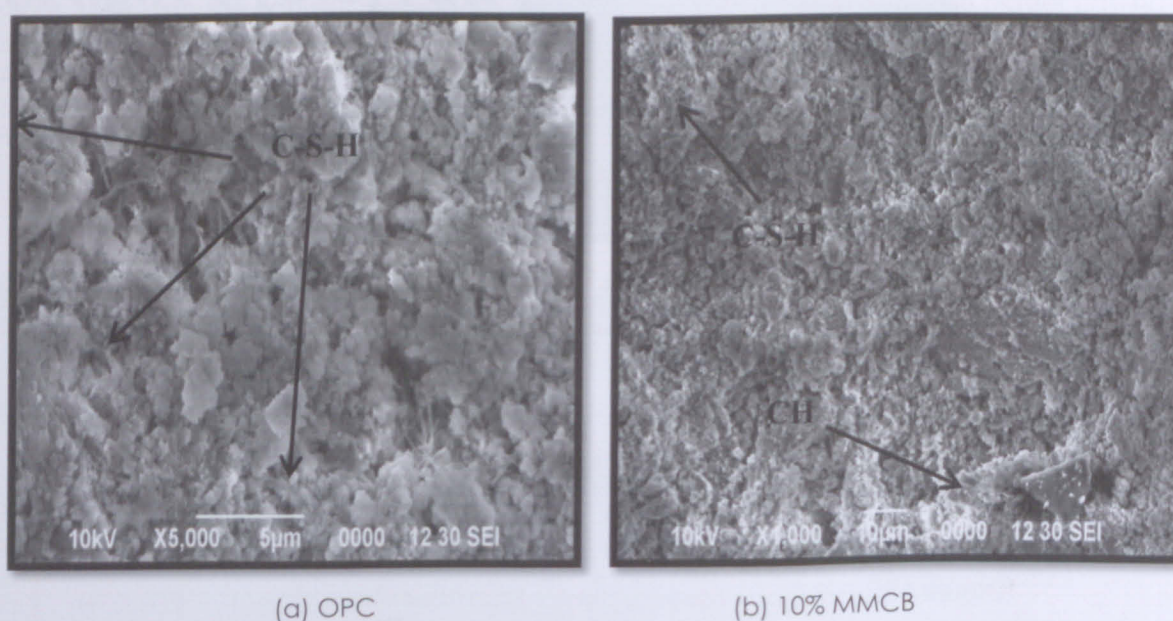


Figure 1. SEM images of (a) OPC and (b) 10%MMCB

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RESEARCH NEWS

Materials Characterization Workshop Series 1: XRD, DSC, DMTA, SEM and EDX

17th September 2014
Faculty of Engineering, UNIMAS

The First series of Materials Characterization Workshop took place on the 17th September 2014 in the Faculty of Engineering. The academic workshop was co-organised by the Faculty of Engineering and Centre for Applied Learning and Multimedia (CALM). The aim of the workshop was to start a platform of interactions and collaboration between researchers within the Faculty with the same interest in Material Characterization as an interdisciplinary subject. The workshop was chaired by Dr. Norsuzailina Mohamed Sutan from Department of Civil Engineering while Assoc. Prof. Dr. Siti Noor Linda Taib from Department of Civil Engineering and Mr. Ibrahim Yakub from Department of Chemical Engineering and Energy Sustainability, were part of the organizing team.

The workshop was a huge success with a total of 42 participants attending this 1st of this series, to enrich their knowledge on material characterization techniques specifically XRD, DSC, DMTA, SEM and EDX. Faculty of Engineering's own expert speakers Prof. Dr. Amir Azam Khan and Prof. Dr. Sinin Hamdan shared their expertise with the participants through facts, information, and hands on training. The workshop was divided into two sessions. Morning session started with Prof. Dr. Amir Azam Khan delivering overview of characterization techniques including importance of characterization, basic principle, classification, surface characterization and molecular characterization. He also described the morphology and structural characterization using SEM and EDX and showed how the scanning electron microscopy works through a special hands-on session with the participants. Prof. Dr. Sinin Hamdan with his vast experience in this field shared the afternoon session by giving detailed presentation about structural and thermal characterization using XRD, DSC and DMTA.



Prof. Dr Amir Azam Khan and Prof. Dr Sinin Hamdan sharing their experience with the participants of the Materials Characterization Workshop

Faculty of Engineering Seminar Series

The Faculty of Engineering is actively involved in holding seminar series which showcase the research work conducted by members of the faculty throughout the year. The seminar series held this year includes:

1. The Mechanical Properties of Recyclable Hemp-Based Fibre Composites by Dr Siti Kudnie Sahari on 27 November 2013
2. Analysis of Electromagnetic field from a moving source by Dr Shafrida Sahrani on 5 February 2014
3. How drying technique and gel chemistry effect the durability indicator of alkali activated materials by Dr Idawati Ismail on 12 February 2014
4. Normal Modes of a small gamelan gong by Professor Dr Sinin Hamdan on 5 March 2014
5. Development of low group delay CMOS power amplifier for UWB communication by Dr. Rohana Sapawi on 12 March 2014
6. Soft error analysis on C-element by Mr. Norhuzaimin Julai on 2 April 2014
7. Qualitative Data Analysis: Introduction to ATLS.ti by Mr. Rasli Muslimen and Dr. Ana Sakura Zainal Abidin on 9 April 2014

8. A new geometrical approach to solve inverse kinematics of hyper redundant robots with variable links length by Mdm. Annisa Jamali on 28 May 2014
9. Effect of hollow PES-PVP-Ag on 5 types of bacteria by Mr Khairul Anwar Mohd Said on 25 June 2014.

Design and Fabrication of Controlled Atmosphere glove box at the Department of Mechanical and Manufacturing Engineering

Faculty of Engineering, UNIMAS



The technicians of the Department of Mechanical and Manufacturing Engineering standing by the Inert Atmosphere glove box.

While working with reactive chemicals an inert atmosphere is mandatory. One such device commonly used for working with reactive and sensitive to air/moisture chemicals is an inert atmosphere glove box. Such glove boxes are connected to vacuum pump and an inert gas cylinder. The Department of Mechanical and Manufacturing Engineering recently completed the design and fabrication of a similar glove box. This device was fabricated and used for work under the DPI grant 02(DPI08)/824/2011(08) by Prof. Dr Amir Azam Khan. The Assistant Engineers involved in the project were Mr. Mohd Rhyier Juen Abdullah @ Rhyier AK Juen, Mr. Sabariman Bakar and Mr. Ireman Bolhassan.

The device produced at the Faculty has an advantage over the commercially available similar devices that it can accommodate large number of bottles, measuring equipment, glassware and mixing equipment due to its convenient large size. Other considerable advantage is the cost of fabrication and parts, which is less than 1/2 of the commercial cost if a similar but smaller device is purchased from the market. The Faculty of Engineering, through their expertise, can now make such devices on order if required and requested by other faculties of UNIMAS.

Technical Visit to Bau Palm Oil Mill Sdn Bhd and Stenggang Oil Palm Plantation Sdn Bhd



A team of 12 academic staff from the Department of Mechanical and Manufacturing Engineering, together with four other interested academic staff, and three postgraduate students from the other three departments in Faculty of Engineering have visited Bau Palm Oil Mill Sdn Bhd (BAPOM) and Stenggang Oil Palm Plantation Sdn Bhd in the morning of 19th August 2014.

The main purpose of the visit was to make a preparation to provide final year undergraduate students with real engineering problems. As part of the curriculum for the Mechanical and Manufacturing Engineering Programme, it is compulsory for the final year students to undertake an integrated design course. This course intends to expose the students to real engineering problems in collaboration with the relevant industries by applying and integrating knowledge from courses learnt up to their third year. The visit also provided an opportunity for the participants to explore research collaboration with Sarawak Land Consolidation and Rehabilitation Agency

(SALCRA), who owned a number of palm oil mills and oil palm plantations throughout Sarawak.

The manager of BAPOM, Mr Krishan Singh, who has more than 30 year experience in palm oil mill was in hand to give a presentation on the mill process, followed with a fruitful discussion on future collaboration between Faculty of Engineering and BAPOM. Three of his engineers were in hand to explain the processes in more detail during the plant tour in order to view the overall process of the mill.

After having lunch which was provided and prepared by BAPOM, the team visited Stenggang Oil Palm Plantation Sdn Bhd in the afternoon. During the plantation walkabout, guided by SALCRA's Regional Manager for Bau and Lundu, Mr Bobby Sangei, the team members learned about the latest mechanization used in oil palm plantation. A discussion with the plantation managers present during the visit give an hindsight on challenges to improve productivity of oil palm plantation throughout Sarawak that heavily depended on foreign labours.

The team members were given a warm welcome by staff from both palm oil mill and oil palm plantation during the technical visit. In general, the visit was very fruitful and offers a great collaboration opportunity between Faculty of Engineering and SALCRA in research and consultancy work.



Briefing from SALCRA's Regional Manager for Bau at Steggang Plantation Oil Palm Sdn Bhd



Briefing from engineers during plant tour at Bau Palm Oil Mill Sdn Bhd

UNIMAS Wins 1 Diamond, 4 Gold Medals and One Bronze at the 2014 British Invention Show



AP Dr Abu Saleh Ahmed

UNIMAS once again forged its name in the 15th British Invention Show' (BIS), held in London from 22 to 25 October, 2014. UNIMAS Inventors grabbed 1 Diamond and 4 Gold Medals in addition to bronze medal. This follows from a very strong showing in the same competition in 2012, when UNIMAS inventors were rewarded with 11 Gold Medals.

This year, the Faculty of Engineering was well represented in this glorious effort. It took home one Special Award Diamond Medal, one Gold Medal and one Bronze Medal. The products that captured the attention of the judges and were honoured with the Diamond and Gold Medal Awards was entitled 'Novel Enzymes for Biofuel' presented to Associate Professor Dr Abu Saleh Ahmed of Mechanical and Manufacturing Engineering. Another product from the same inventor managed to obtain a Bronze Medal for the invention entitled 'Novel Catalyst for Algae Biodiesel'.

Faculty of Engineering captures best poster award and a bronze medal at the National Geofest 2014

A group of 3 civil engineering students (Er Hauzhi – leader, Nurul Izzati bt. Ahmat @ Ibrahim and Phillip ak. Owen), accompanied by Dr Fauzan Sahdi competed in the first National Geofest 2014 competition organized by UTHM on 5th to 6th November 2014. The topic for Geofest 2014 was "Development of Procedure to Measure Highly Organic Soil/Peat Permeability – From Site to Laboratory". The work was supervised by Dr Fauzan Sahdi and Associate Professor Dr Siti Noor Linda bt. Taib from Department of Civil Engineering. 26 groups from various universities across Malaysia were competing for the honors. UNIMAS team won the best poster award and a bronze medal on the work presented by its team at the competition.

13th IAHR/IWA International Conference on Urban Drainage (ICUD2014)

Borneo Convention Centre Kuching, Sarawak
September 7 – 12, 2014



Opening Ceremony by Dato' Sri Dr James Dawos Mamit (Photo Courtesy of Dr Charles Bong)

ICUD2014 was organized by the Ministry of Natural Resources and Environment, Department of Irrigation and Drainage (DID) Malaysia, International Water Association (IWA) and International Association for Hydro-Environment Engineering and Research (IAHR). The co-organizers for the conference consisted of faculty members of Universiti Tenaga Nasional (UTN) and Universiti Malaysia Sarawak (UNIMAS). The theme of the conference was "Urban Drainage in the Context of Integrated Urban Water Management: A Bridge between Developed and Under Developed Countries".

It was the first time Malaysia to hold such a conference with Kuching city chosen as the venue. The conference was aimed at looking at the most recent ideas, technologies, behaviours, economics and policies related to centralised and decentralised systems for managing urban drainage as part of an integrated approach to the water cycle.

The five-day conference at the Borneo Convention Centre Kuching (BCKK) received more than 500 delegates from all over the world, with six keynote papers and over 300 technical papers presented. The important outcome of the ICUD2014 was that everyone now acknowledged that problems regarding urban drainage were complex and controversial. Twelve resolutions were passed and listed below:

1. Urban drainage systems should be reliable, resilient and sustainable to ensure long-term performance within planetary and social limits by developing, evaluating and implementing save and sure socio-technical systems.
2. Urban water management practices are solutions to mitigate the impact of urbanisation and climate change in urban areas.
3. Developing an understanding of urban water management issues and best management practices (BMPs) either for developed and developing countries.
4. Establishment of recent ideas, methods, models, technologies, economics, policies and perceptions related to centralised and decentralised systems for managing urban drainage as part of an integrated approach to the water cycle which suits the local conditions.
5. Developing resilient green infrastructure for the urban environment is important at both the micro and macro scales for our future cities whether in developed or developing countries.
6. Sharing urban drainage databases between developed and developing countries.

7. Research and development (R&D) to support the knowledge related to urban water management facilities.
8. Acceptance and compliance by stakeholders.
9. Institutional or legislation provision to achieve sustainable urban drainage systems.
10. Operation and maintenance as key factors for successful urban drainage systems.
11. Education and awareness related to urban drainage systems.
12. Capturing the fundamental importance of water for both humans and the environment, securing sustainable water for all.

Team from Mechanical and Manufacturing Engineering won Excellent Paper Award at iCAAA 2014

Krabi, Thailand

iCAAA is an international conference jointly organized by American-Eurasian Network for Scientific Information and International Postgraduate Network that covers a wide range of research from science and engineering, applied sciences and agricultural businesses. The paper presented by Dr Mohd Danial and team, "Durable Hybrid-Powered White Pepper Retting Machine Integrated with Crude Enzymatic Solution, by Ibrahim, M.D., R.Iskandar, N.A.N., Ibrahim, M.D., Ashaari, M.F., Zulkarnain, A. and A.Hussaini, A.A.S." was one of the two excellent papers selected in this conference. This work is a collaborating research activity of Mechanical Engineering Department with Department of Molecular Biology lead by Dr Azham Zulkarnain.



Dr Danial Ibrahim from Mechanical and Manufacturing Engineering and team has won the Excellent Paper Award at the iCAAA 2014

The content of the paper is related to an innovated way of retting the white pepper utilizing a new integrated mechanical and chemical way to produce white pepper using enzymes. Apart from application of friction forces generated between the blade and inner wall of the skin of the berries, the enzymatic solution will help accelerating the retting process, suitable for efficient mass production of high quality cottage industries of white pepper. The integration improved the production time as much as three times at current un-optimized ratio of enzymes used in the solutions. The same project once won an Honor of Invention Award from World Invention Intellectual Property Association in 2013. The project is funded by Ministry of Education Malaysia under the Prototype Research Grant Scheme, Grant No: PRGS/1/2013/SG06/UNIMAS/02/1 and Research Acculturation Grant Scheme, Grant No: RAGS/c(4)935/2012(36).

Upon receiving the award, Dr Danial stated "It is an honor to have our research recognized internationally. With this encouragement, we hope to be able to connect it to commercialize-able product in the near future."

Research Visit to other Universities or Industries



Visit to Dewan Bandaraya Kuching Utara (DBKU)

19 April 2013: Courtesy Visit to Ir. Wong SH, Director, Department of Irrigation & Drainage Sarawak.

1. 12 June 2013: Visit to Dewan Bandaraya Kuching Utara, Petra Jaya, Sarawak.
2. 10 March 2014: Courtesy Visit to Ir Jamesy Mijek, Assistant Director, Department of Irrigation & Drainage Sarawak.
3. 23 October 2014: A team of 4 engineers and technical staff from MEMC Kuching visited the Department of Chemical Engineering & Energy Sustainability. The visit was intended to do collaboration in the field of analysis of lubricants used for cutting the silicon wafer at MEMC.

Post Graduate Proposal Defence Organized at the Faculty of Engineering

24th September & 1st October 2014
Faculty of Engineering, UNIMAS



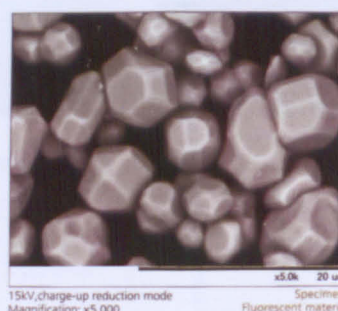
Post Graduate students and Faculty members attending the Proposal Defence at the Faculty of Engineering

The First Post Graduate Proposal defence was organized at the Faculty of Engineering on 24th September and 1st October 2014. A total of 18 Post Graduate students registered in Masters and PhD during the fall 2013 presented their proposal defence in front of an open gathering which also included selected panel members to evaluate the proposal. The interaction between presenting students and Faculty members turned out to be very useful as it helped to understand, improve and appreciate the proposal as well as some initial work conducted by the students. Some useful suggestions given by the expert evaluators during the Q&A session were also very much appreciated by the presenting students. The presentations were divided into 6 working sessions with each session being grouped around a similar theme. Each session also had three evaluators panel appointed for evaluation of the presentations given during the session. The Faculty of Engineering plans to make this proposal defence a regular feature in future, to be organized 2 times a year for those students who have completed between 6 months to 12 months in their respective program. The activity reinforces the Faculty's policy of Continuous Quality Improvement (CQI) for its Post Graduate program. The proposal defence twice a year and a yearly organized Post Graduate Colloquium, started in 2013, are expected to markedly improve the quality of Post Graduate Research conducted at the Faculty of Engineering.

Recent Research Facilities at the Faculty of Engineering

Scanning Electron Microscope (SEM) installed at the Department of Mechanical and Manufacturing Engineering

A Scanning Electron Microscope (SEM) was installed at the Department of Mechanical and Manufacturing Engineering in July 2014. The table top version (Hitachi TM3030) is capable of working with a 15,000 V electron beam and can attain up to 30,000x magnifications. This ultra-compact model which has been upgraded recently by Hitachi, from its previous TM3000 model, is a very handy tool as it comes with a dry primary vacuum pump and a secondary turbo-molecular pump which allows to achieve a suitable vacuum level in the shortest possible time. The samples can be observed in coated as well as un-coated condition, whereas for maximum quality of images, a coated sample is recommended. The equipment is associated to an already present sputter coater which can cater for non-conducting samples by coating them with either gold or platinum films. The Faculty and Post Graduate students can observe with this equipment their samples as big as 30 mm diameter



Scanning Electron Microscope (SEM) with a selected picture obtained under 15,000 V electron beam

Collaboration with Other Universities/Organisations

A UNIMAS delegation headed by VC Prof. Dato Dr Mohamad Kadim Suaidi, including Prof. Wan Hashim Wan Ibrahim, Dean Faculty of Engineering and Prof. Dr Amir Azam Khan from Department of Mechanical and Manufacturing Engineering, visited France from 18 to 23 March, 2014. During this visit the delegation met the Regional Director of French Ministry of Higher Education and Advisor to Scientific Cooperation and Research with Asia-Africa Region. Several important matters of collaboration in research were discussed. The French Ministry has shown its willingness to support any research activity conducted in collaboration with French universities. During the same visit, three French Universities, namely, University Cergy-Pontoise, Paris, University of Limoges, Limoges and University of Nice, Sophia Antipolis, Nice, were also visited. Active collaboration is already underway with University of Limoges in the field of Materials Engineering. Both sides agreed to sign a long term MoU which will further widen the scope of collaboration to other Faculties, especially in Tropical Diseases and Forestry.

Universiti Malaysia Sarawak (UNIMAS) signed a Memorandum of Understanding (MoU) with CMS Pavement Tech Sdn Bhd (CMSPT) on 27th September 2013. The MoU was signed by Prof. Dato' Dr. Mohamad Kadim Suaidi, Vice Chancellor of UNIMAS and Mr Lim Jit Yaw, CMS Head of Construction & Road Maintenance Division, respectively. The second signatory from UNIMAS was Prof. Dr. Wan Hashim Wan Ibrahim, representing Faculty of Engineering and Mr John Lim, CMS Legal Manager. The MoU between UNIMAS and CMSPT is signed in view to promote the two parties by performing collaborative research and development activities. The Department of Civil Engineering is the major collaborator with CMS Pavement Tech Sdn Bhd which is involved to improve the engineering quality of roads in the state of Sarawak.



UNIMAS delegation visiting the Laboratory of Electronics and Microwave Engineering, University of Limoges, France.



MoU with CMS Pavement Tech

Talks and Seminars

The Faculty of Engineering, UNIMAS encourages collaboration with different industries and one such way is by organising talks and seminars. A number of interesting talks and seminars were given by prominent researchers and practitioners from around the globe. Below is a list of talks and seminars organised in collaboration with the Faculty of Engineering in 2012:

1. Public lecture on "Climate Change and biodiversity from the perspective of diplomatic and technology as well as the experience of Japan in rebranding its technology and innovation" by Prof. Horie Masahiko, Ambassador of Global Environment Affairs, Japan on 20 February 2013.
2. Public Lecture on "Construction Management–Past, Present and Future" by Prof. David Scott from Curtin University of Technology, Perth on 8 May 2013.
3. Seminar on Civil Engineering delivered by Prof. Goh Bean San from Curtin University Sarawak on 16 August 2013.
4. Talk on "Rethinking Green Infrastructure: Beyond the streetscape" by Mr. Augustine CM Wong from USA professional architect on 17 October 2013.
5. Research and Education in Geotechnical Engineering from Universiti Malaysia Sarawak on 13 and 14 November 2013.



Talk by Prof. Horie Masahiko



Talk by Prof. David Scott



Seminar conducted by Prof. Goh Bean San

STUDENTS' BEST PAPERS

Synthesis and Characterization of Organically Modified
Ceramics through Sol-Gel Process

¹Syed Salman Shafqat, Sinin Hamdan, Andrew Ragai Henry Rigit, Nicholas Kuan Hoo Tien, Shanti Faridah Saleh
and Amir Azam Khan

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Abstract:

There is an enormous demand for Composites and Hybrid materials as many of the well-established materials, such as metals, ceramics or plastics cannot fulfil all technological desires for the various new applications. Sol-gel process has been extensively studied for several decades as a method to prepare Composites and Hybrid materials. This paper presents a review on the basic concepts related to sol-gel chemistry, major factors affecting the reaction kinetics and surface modification of silica network with organofunctionalized groups for the preparation of homogeneous composites. The ORMOCERS based composites have numerous applications, notably when grafted with heterocyclic amines. The insertion of organometallic precursors in sol-gel process to get transition metal embedded ORMOCERS subsequently grafted with heterocyclic amines are proposed in this work. These composites and hybrid materials are expected to be optically active within the visible range. These can be eventually used as optical brighteners and dyes in the textile industry.

Keywords: ORMOCERS, Composite materials, Sol-Gel, Hybrid materials

Road Subsurface as Component of On-site Detention
(OSD) Urban Drainage System

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Abstract

On-site Detention (OSD) System is part of the proposed measures in Manual Saliran Mesra Alam (MSMA). It has been widely applied in Sydney since 1991; where developers provide detention storage for stormwater on their project sites to limit rates of runoff. This research is to investigate the application of road subsurface as components of OSD Urban Drainage System by using Storm Water Management Modeling (SWMM). The application of road subsurface as OSD system rather than open spaces is to overcome the problem of limitation of land. The water is infiltrated through permeable pavement and then flow into the detention storage under the road. Attempts are made to store stormwater as a temporary storage in order to reduce the volume of surface runoff, and later slowly release with time in safe rate. This study examines the new sub-surface stormwater control system designed for detention purposes, which the model predicts a reduction of 93% in peak runoff. The permeable pavement system is encouraged due to the several benefits such as reduction in surface runoff, soil improvement and water treatment through infiltration. Furthermore, using the road subsurface as urban drainage encourage more efficient land use where road can be directed to be multi-purpose infrastructure.

Keywords: Manual Saliran Mesra Alam, Storm Water Management Modeling, permeable pavement

Utility Function in Broadband Wireless Network

Olalekan Bello, Hushairi Zen, Al-Khalid Othman and Khairuddin Ab Hamid

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Abstract

All the scheduling algorithms compared in the report use utility function in their scheduling policies to perform resource allocation in a heterogeneous traffic scenario where the base station (BS) and subscriber stations (SSs) are each assumed to be equipped with single antenna. Therefore, the optimization problem is formulated as a utility-weighted sum rate maximization incorporating both uniform power allocation (UPA) and continuous rate allocation (CRA) strategies. The proposed maximum qos-guaranteed (MQG) algorithm is a delay-sensitive rule that provides services in systems with deadline requirement while the MLWDF and MDU (also delay-sensitive rules) deal with services with absolute delay requirements. The MSR is classified as a delay-insensitive scheduling rule. The MQG compared to the existing scheduling rules such as MSR, MLWDF and MDU is found to perform better in terms of throughput, delay and queuing stability. Although slightly outperformed in terms of fairness, its average fairness performance index is still above 0.96. Both the MLWDF and MDU although obtain higher system performances compared to MSR, they still prove unable to handle more complicated QoS requirements than that of MQG rule. The results also clearly demonstrate and confirm that a channel-aware-only scheduler such as the MSR cannot be used in heterogeneous traffic environments as its system performances including queuing stability are noticeably very poor.

Keywords: resource allocation, fairness, throughput, delay, utility, stability

STUDENT NEWS

Colloquium Curtin-UNIMAS 2014



The 2nd Faculty of Engineering Postgraduate Colloquium 2014 was successfully held on 23rd April 2014, at Curtin University Sarawak. The event was organized by Curtin University Sarawak and co-organized by UNIMAS. This was the first collaboration event under the **Memorandum of Understanding (MoU)** between UNIMAS and Curtin University. The objectives of the Postgraduate Colloquium are:

- (i) to provide a platform for postgraduate students to present the progress of their work,
- (ii) to obtain constructive feedbacks and comments by engaging themselves in stimulation dialogues,
- (iii) to evaluate and monitor the progress of postgraduate by research (for both full time and part time).

The theme for the colloquium is "Research Trends in Engineering and Business", which reflects the specialization of the participating researchers from both universities. There are 7 sub-themes for the colloquium; (1) Chemical Engineering, (2) Civil Engineering, (3) Electrical and Electronic Engineering, (4) Mechanical Engineering, (5) Science and Foundation, (6) School of Business, (7) Curtin Sarawak Research Institute.

There were 28 participants from UNIMAS, of which 24 participants presented orally while the other 4 were poster presentations. The closing ceremony started at 5.15 pm for awards ceremony and vote of thanks. Each individual university was given 3 Best Paper Awards and 1 Best Poster Award.



Winner Mr Syed Salman Shafqat



1st Runner up Ms Nam Nguk Chiu



Second runner up Mr Olalekan Bello



Winner for poster presentation Ms Nadia Zaini

For UNIMAS, the Best Paper Awards were given to Syed Salman Shafqat, Nam Nguk Chiu and lastly Bello Olalekan. The Best Poster Award for UNIMAS was given to Nadia Zaini. Certificates of participation and souvenirs were given to UNIMAS participants by Curtin University. This colloquium successfully ended at 6.00pm.

Research Students

Civil Engineering

Name	Level	Type	Supervisor	Co-supervisor(s)	Title
Nur Afnie Faryisha binti Mohamad Hamzah	Master	Full Time	Rosmina binti Ahmad Bustami	-	Design of Long Storage for Excess Water and Development of Hydrological Framework in Sungai Sarawak Kanan Sub-Basin
Tay Chiaw Teck	Master	Part Time	Prof Dr Wan Hashim bin Wan Ibrahim	-	Analyzing Two-Way Two-Lane Highways Based on Malaysian Road Condition
Oon Yin Wee	PhD	Full Time	Prof Ir Dr Law Puong Ling	Dr Lim Soh Fong / Prof Dr Kopli Bujang	A Novel Oil and Grease (O&G) Removal Apparatus with Curved Coalescence Frustums and Triangular Surface Restraints
Chong Kok Hing	PhD	Full Time	Prof Ir Dr Law Puong Ling	Prof Ir Dr Andrew Ragai Henry Rigit / Dr Rubiyah binti Haji Baini	Biomass-to-Heat Energy Converter for Drying Purpose in the Production of Paper Egg Trays
Freddy Kho Wee Liang	PhD	Full Time	Prof Ir Dr Law Puong Ling	Prof Ir Dr Andrew Ragai Henry Rigit	Carbon Monoxide Levels Along Roadway
Bong Chien Chai	Master	Full Time	AP Dr Azhaili bin Baharun	Abdul Azim bin Abdullah / Rosmina binti Ahmad Bustami	Turbine Float System and Achorage Design
Franklin Simon	Master	Full Time	Ron Aldrino Chan @ Ron Buking	Ir Dr Ting Sim Nee / Dr Tay Kai Meng	The Use of Fuzzy Inference System for Risk Assessment and Decision Making for Sarawak River Transport
Lau See Hung	PhD	Full Time	Prof Dr Ng Chee Khoon	Dr Tay Kai Meng	Development of a Data Driven Fuzzy System for Evaluating Ultimate Tendon Stress and Flexural Strength of Externally Prestressed Beams
Chiew Fei Ha	PhD	Full Time	Prof Dr Ng Chee Khoon	Dr Tay Kai Meng	Optimization of Mix Proportion for High Strength Concrete Based on Harmony Search
Aliyu Haliru Hong	PhD	Full Time	Prof Ir Dr Law Puong Ling	Dr Onni Suhaiza Selaman	Wastewater Reuse and Its Health Implication on Irrigated Vegetable at Lake Geriyo Irrigation Project, Yola, Adomawa Estate, Nigeria
Mohammad Fadzli bin Jawawi	Master	Part Time	Dr Siti Noor Linda Taib	-	Stabilization of Peat Soil Using Fly Ash and Sago Ash at Kampung Sau, Mukah
Lee Lin Jye	PhD	Full Time	Prof Dr Shenbaga Kaniraj Rajaratnam	AP Dr Siti Noor Linda Haji Taib	Analyse the Lateral Movement on Soft Riverbank
Lai Phui Hua	PhD	Part Time	AP Dr Haji Mohd Ibrahim Safawi Mohd Zain	AP Dr Siti Noor Linda Haji Taib	A Proposed Design Procedure for Replacement of Saturated Peat Soil with Foamed Concrete
Muhammad Abdul Syahid bin Saari	Master	Full Time	AP Dr Haji Mohd Ibrahim Safawi Mohd Zain	-	The Roles of Constituent in Achieving Self-Compactibility Criteria for Self- Compacting Concrete
Thong Chia Chia	Master	Full Time	Dr Delsye Teo Ching Lee	Prof Dr Ng Chee Khoon	Structural and Durability Properties of Concrete with Polyvinyl Alcohol (PVA) Coated Oil Palm Shell (OPS) as Lighweight Aggregates Under Different Curing Conditions

Nafisa Tamanna	Master	Full Time	Dr Norsuzailina Mohamed Sutan	Dr Delsye Teo Ching Lee / Ibrahim Yakub	Parametric Study on Utilizing Waste Glass as a Finely Ground Mineral Additive (FGMA) in a Modified Multi-Component Binder (MMCB) Durable Eco-Friendly Cement System
Lee Shyue Leong	PhD	Full Time	Prof Dr Md Abdul Mannan	Prof Dr Wan Hashim Wan Ibrahim	Investigation on Potential Use of Rice Bran as Alternative Material in Bituminous Mixture
Riji Burmanu Benjamin	PhD	Full Time	Prof Ir Dr Law Puong Ling	-	Modeling of Environmental Pollution from Decayed Vegetables in the Face of Climate Change in Northeast, Nigeria
Eric Yong Pik Kwong	Master	Full Time	Dr Delsye Teo Ching Lee	Dr Norsuzailina Mohamed Sutan	The Engineering Properties of Concrete Containing Waste From the Oil Palm Industry
Yong Leong Kong	PhD	Full Time	Prof Ir Dr Law Puong Ling	Dr Hajah Siti Noor Linda Haji Taib, Dr Darrien Mah Yau Seng	Model Development of Riverbank Erosion at Batang Rejang
Stripabu a/l Strimari	PhD	Full Time	AP Dr Siti Noor Linda Haji Taib	Dr Norazzalina M. Sa'don	Chemical Stabilization of Sarawak Soils as Pavement Subbase
Jerren Tan Yun Ping	Master	Full Time	Ir Dr Ting Sim Nee	AP Dr Azhaili Baharun	Procurement Route Selection Guideline for Construction Projects in Malaysia
Nam Nguk Chiu	Master	Full Time	Dr Darrien Mah Yau Seng	Prof Dr FJ Putuhena	Road Subsurface as Component of On-Site Detention (OSD) Urban Drainage System
Alifia Hamzah Bin Johari	PhD	Full Time	Prof Ir Law Puong Ling	AP Dr Siti Noor Linda Taib	Study Of Peat Soil Erosion Rate, Sediment Yield And Slope Stability For Application In Equatorial Region
Dayang Rozina Binti Abang Madni	Master	Part Time	Dr Gaddafi Bin Ismaili	-	Physical And Mechanical Properties Of Three-Fast Growing Plantation Species In Sarawak
Ir. Jamil Bin Matarul	PhD	Part Time	Prof Dr Md Abdul Mannan	AP Dr Mohammad Ibrahim Safawi	Enhancing Service Life Of RC Structures For Chloride Belt Area Through Durability-Based Concrete Properties
Lau Pei Ching	PhD	Full Time	Prof Dr Md Abdul Mannan	Dr Delsye Teo Ching Lee	Performance Of Lightweight Aggregate Using Sewage Sludge And Oil-Palm-Boiler Waste
Lim Hung Ling	PhD	Full Time	Prof Dr Md Abdul Mannan	Dr Delsye Teo Ching Lee	Structural Performance Of Precast Honeycomb Pavement
Moh Hiong Teck	Master	Full Time	AP Dr Siti Noor Linda Bt Taib	Dr Onni Suhaiza Selaman	A Study On New Slope Drainage Design Under The Effect Of Rainfall Infiltration And Ground In Tropical Region
Muhammad Syukri Imran Bin Abdullah	PhD	Part Time	AP Dr Azhaili Bin Baharun	Dr Siti Halipah Ibrahim	Designing A Hydronic Radiator Panel For Building To An Acceptable Operative Temperature Through The Use Of Thermal Modeling And Simulation
Nadia Zaini	Master	Full Time	Dr Siti Halipah Ibrahim	AP Dr Azhaili Bin Baharun	Energy Consumption Assessment On Industrialized Building System (IBS)
Nur Izaitul Akma Binti Ideris	PhD	Full Time	Dr Norsuzailina Binti Mohamed Sutan	Dr Siti Halipah Ibrahim	Coatings Bio-Resistance Test Of Different Wall Finishing By Using Potassium Sorbate For Indoor Fungal Treatment
Nurul Amal Binti Yusuh	Master	Full Time	Prof Dr Md Abdul Mannan	Dr Raudhah Ahmadi	Enhanced Mechanical Properties Of Medium Strength Self-Compacting Concrete Through Hybridisation And Synergistic Effects Of Fibres

Qairuniza Binti Roslan	Master	Full Time	Dr Siti Halipah Bt Ibrahim	Rohaida Affandi	Optimum Roofing Design Concept For Hot Humid Climate.
Shilya Zulaikha Binti Zamani	Master	Full Time	Prof Dr Frederik Josep Putuhena	Dr Charles Bong Hin Joo	Strategic Planning for Integrated Rajang River Basin Development
Suriana Yussof	PhD	Part Time	Ir Dr Ting Sim Nee	Dr Siti Halipah Ibrahim	Contractor's Right-Later Payment And Non-Payment Under Malaysian Construction Contracts
Tengku Noor Ain Binti Tengku Hasbullah	Master	Full Time	Dr Onni Suhaiza Binti Selaman	AP Dr Siti Noor Linda Taib	Removal Of Emerging Contaminant From Dye Wastewater Into Soil By Using Shell And Coal As Adsorption Material
Zulhelmi Bin Abdul Manap	Master	Part Time	Dr Onni Suhaiza Binti Selaman	Dr Mah Yau Seng	Evaluation Of Peak Design Discharge For Small Scale Development In Sarawak
Tengku Noor Ain binti Tengku Hasbullah	Master	Part Time	Dr Onni Suhaiza Selaman	AP Dr Siti Noor Linda Taib	Removal of Emerging Contaminant from Dye Wastewater into Soil by Using Shell and Coal as Adsorption Material
Chai Chern Tcian	Master	Full Time	Prof Dr FJ Putuhena	Dr Onni Suhaiza Selaman	Study on the Hydrological Performance of Green Roof as Potential Stormwater Management Practice in Sarawak
Alifia Hamzah bin Johari	PhD	Full Time	Prof Ir Dr Law Puong Ling	AP Dr Siti Noor Linda Taib	Study of Peat Soil Erosion Rate, Sediment Yield and Slope Stability for Application in Equatorial Region
Ho Lee Lee	PhD	Full Time	Prof Ir Dr Law Puong Ling	Dr Lim Soh Fong	Development and Evalution of a Deterministic Methodology for Measuring the Effectiveness of Environmental Management System (EMS)
Bayu Mahista Tamtomo	Master	Full Time	Dr Mohamad Raduan Kabit	-	Hybrid Expert System for Diagnosis of Flexible Pavement Deterioration and Rehabilitation Strategies

Electrical and Electronics Engineering

Name	Level	Type	Supervisor	Co-Supervisor(s)	Title
Saleem Ahmad Saleem Jayousi	PhD	Full Time	AP Dr Mohd. Saufee bin Muhammad	-	Computerized Maintenance for Electronic Instrument
Chai Nee Ping	PhD	Full Time	AP Dr Wan Azlan bin Wan Zainal Abidin	AP Dr Al-Khalid Haji Othman / Dr Hushairi Zen	Real-Time Heavy Vehicle Monitoring using GPS and GIS Technology
John Tin Yuan En	PhD	Full Time	AP Dr Wan Azlan bin Wan Zainal Abidin	AP Dr Azhaili bin Baharun / AP Dr Al-Khalid Haji Othman	Adaptive Solar Energy System for Low-Cost Home Cooling System
Ng Liang Yew	PhD	Part Time	Dr Hushairi Zen	AP Dr Al-Khalid Haji Othman	Tracking with Non-Line-of-Sight (Nlos) Mitigation in Indoor Environment
Jong Chian Haur	Master	Full Time	Dr Tay Kai Meng	-	Development of a Single-Input-Rule-Module Fuzzy Inference System-Based Failures Prioritization Technique for Edible-Bird's Nest Processing
Marta a/p Elizabeth	Master	Full Time	Dr Kismet Hong Ping	AP Dr Wan Azlan bin Wan Zainal Abidin / Dr Nordiana Rajae	Time-Domain Inverse Scattering Technique for Early Breast Cancer Detection
Chai Kok Chin	PhD	Full Time	Dr Tay Kai Meng	Prof Dr Ng Chee Khoo	Development of Type 2 Fuzzy Logic Based Decision Making Support Model/ Software Prototype for the Application in Local (Sarawak) Industries

Chang Wui Lee	Master	Full Time	Dr Tay Kai Meng	-	Development of an Evolving Fuzzy Rule-Based System for Object Detection in Video
Puteh Munawwarah binti Ibrahim	Master	Full Time	Dr Kismet Hong Ping	Dr Nordiana Rajae	Reconstruction of Breast Composition Utilizing Filtered Forward-Backward Time-Stepping (FBTS) Inverse Scattering Technique
Kang Chia Yang	Master	Part Time	Dr Hushairi Haji Zen	AP Dr Al-Khalid Haji Othman / Hazrul Mohamed Basri	Cause and Effect of Low Power Quality in Homes and Industries in Sarawak
Yong Guang	PhD	Full Time	Dr Kismet Hong Ping	AP Dr Al-Khalid Haji Othman / Dr Thelaha Haji Masri	Filtered Forward-Backward Time-Stepping Inverse Scattering Technique for Buried Object Detection and Shape Reconstruction
Ng Shi Wei	PhD	Full Time	Dr Kismet Hong Ping	Dr Hushairi Haji Zen / AP Dr Wan Azlan Wan Zainal Abidin	Microwave Imaging Reconstruction of Breast Composition Utilizing Filtered Forward-Backward Time-Stepping Technique for Breast Cancer Detection
Andrew Sia Siew Chie	Master	Full Time	Dr Kismet Hong Ping	Dr Nordiana Rajae	Detection of Buried Objects in Dispersive Medium Utilizing Filtered Forward-Backward Time-Stepping Inverse Scattering Techniques
Therry Lee Zee	Master	Full Time	Ir David Bong Boon Liang	-	Multimodal Biometric Recognition Based on Bil-Plane Extraction
Nurliyana binti Hussaini	Master	Full Time	Dr Thelaha Haji Masri	AP Dr Wan Azlan Wan Zainal Abidin / Dr Kismet Hong Ping	Performance Enhancement of Microstrip Antennas Using Electromagnetic Band Gap Structures
Florence Francis Lothai	Master	Full Time	Ir Dr David Bong Boon Liang	-	An Analysis of the Effects of using Various Sensors in Biometric Identification
Nuramalina bt Bohari	Master	Full Time	AP Dr Wan Azlan bin Wan Zainal Abidin	Martin Anyi / Dayang Nur Salmi Dharmiza bt Awang Salleh	Solar-hydro Hybrid Controller System Design
Bello Olalekan	PhD	Full Time	Dr Hushairi Haji Zen	AP Dr Al-Khalid Haji Othman	Scheduling in Satellite Networks Employing MIMO Technology
Toh Sheng Wei	PhD	Full Time	Dr Tay Kai Meng	Prof Dr Haji Mohamad Omar Abdullah	Intelligent Performance Optimization Framework for Collaborative Hybrid Energy System
Pang Lie Meng	PhD	Full Time	Dr Tay Kai Meng	Dr Darrien Mah Yau Seng	A New Type-2 Single Input Rule Modules (SIRMs) Connected Fuzzy Interference System-Based Group Decision Support and Assessment System with Engineering Applications
Ibrahim Abba	PhD	Full Time	AP Dr Wan Azlan Wan Zainal Abidin	Dr Kismet Hong Ping / Dr Thelaha Masri	Empirical Model Development for Effect of Ionosphere on Mobile Satellite Signal Performance: Kano and Kota Samarahan
Nurlaila binti Rosli	PhD	Full Time	Dr Nordiana Rajae	Ir Dr David Bong Boon Liang	Applying Neural Network in Emotion Classification of Malay Popular Music Based on Vocal and Instrumental Sound Timbres
Michelle Lu	PhD	Full Time	AP Dr Wan Azlan Wan Zainal Abidin	Dr Thelaha Masri / Dr Dennis Lau Hau Aik (SESCO) / Dr Chen Shiun (SESCO)	Swarm and Evolutionary Techniques for Optimization of Under-Frequency Load Shedding Scheme
Kenny Voo Hon Bing	Master	Full Time	Ir Dr David Bong Boon Liang	Dr Kismet Hong Ping	Structural Similarity Based Image Quality for 3 Dimensional Image

Nor Shafrillah binti Mohd Isa	Master	Full Time	Dr Shafrida Sahrani	Dr Kismet Hong Ping	Overset Grid Generation Method for the Analysis of Electromagnetic Field Around a Complex Moving Body
Mahmood Adnan	Master	Full Time	Dr Hushairi Zen	-	A Smart Decision Algorithm for Vertical Handover in Fourth Generation Heterogeneous Wireless Networks
Mohd Azlan bin Ismail	PhD	Full Time	AP Dr Al-Khalid Othman	AP Dr M. Shahidul Islam	Low Head Modular Microhydro for a Flexible Implementation System
Bong Voon Pai	PhD	Full Time	AP Dr Wan Azlan Wan Zainal Abidin	Dr Thelaha Masri / Dr Kismet Hong Ping	Propagation Models for Low Latitude Region of L-Band Mobile Satellite Signal Performance
Dyg Khayrunsalihaty Bariyyah binti Abang Othman	Master	Part Time	Dr Hushairi Zen	AP Dr Al-Khalid Othman	Distributed Beacon Scheduling Specification Using Link Quality Indicator (Lqi) Approached in WSN
Amy Sahida Binti Soetarman	Master	Full Time	Dr Kismet Anak Hong Ping	Dr Shafrida Sahrani	Microwave Imaging For Breast Tumor Detection Using Pso-Based Segmentation Strategy
Anis Suzziani Binti Roslan	Master	Full Time	Dr Dayang Azra Binti Awang Mat	Dr Kismet Anak Hong Ping	Integrated Filter-Antenna Design For Microwave Breast Imaging System
Arisita Duwi Ak Sapit	Master	Full Time	Dr Kismet Anak Hong Ping	Dr Tay Kai Meng	Reconstruction Of Reinforcement Bars In Concrete Structures Using Electromagnetics Direct Scattering And Pso Techniques For Ndt Applications
Au Yeung Wai Lun	Master	Full Time	Dr Ngu Sze Song	Dr Siti Kudnie Sahari	Termination Structure Design To Improve Robustness/Reliability Of High Voltage Semiconductor Devices Using Si And Sic
Azarina Binti Azman	Master	Full Time	Dr Shafrida Sahrani	Dr Kismet Anak Hong Ping	Reconstruction Of Shape By Applying Overset Grid Generation Method To An Iterative Inversion Technique
Chong Yee Ming	Master	Full Time	Dr Martin Anyi	Dr Lakshmanan A/L Gurusamy	Design Of An Electronic Load Controller (Elc) System For Remote Communities' Micro-Hydro Power Plants
Faralya Aisyah Binti Abdul Rasid	PhD	Full Time	AP Dr Wan Azlan Bin Wan Zainal Abidin	Dr Thelaha Bin Hj Masri	Rural Application Optimization Design For Hybrid Solar PV System
Jam'Aah Binti Suud	PhD	Full Time	Dr Hushairi Bin Zen	Prof Dr Wan Hashim Wan Ibrahim	Road Traffic Management And Monitoring Network
Jee Tze Ling	PhD	Full Time	Dr Tay Kai Meng	Prof Dr Ng Chee Khoon	A New Two-Stage Framework With Generic Algorithm Search And Similarity Reasoning For Constructing Fuzzy Inference Models With Real World Applications
Justin Anak Masiar @ Peton	Master	Full Time	AP Dr Al-Khalid Bin Hj Othman	Dr Hushairi Bin Zen	Optimized Energy Management System For Rural ICT Telecentre: Stand alone Solar PV Power System
Kerk Yi Wen	Master	Full Time	Dr Tay Kai Meng	Dr Mah Yao Seng	A New Interval-Based Method For Monotone Fuzzy Modelling With Engineering Application
Liew Hon Choi	Master	Full Time	AP Dr Wan Azlan Bin Wan Zainal Abidin	AP Dr Al-Khalid Bin Hj Othman	Jarimas Turbine Remote Area Monitoring System
Loh Woei Tan	Master	Full Time	Dr David Bong Boon Liang	Dr Nordiana Rajae	Video Quality Assessment Based On Hybrid PSNR And Optical Flow Estimation

Mohamad Faizal Bin Mahsen	Master	Full Time	Dr Kismet Anak Hong Ping	AP Dr Wan Azlan Wan Zainal Abidin	Detection Of Object Hidden Behind The Wall Using Inverse Scattering Technique
Nik Amni Fathi Bt Nik Zaini Fathi	Master	Full Time	Dr Siti Kudnie Bt Sahari	Dr Rohana Sapawi	Theoretical Formulation Of Interfacial Layer Growth Between High-K And Germanium Surface
Salisu Muhammad Lawan	PhD	Full Time	AP Dr Wan Azlan Bin Wan Zainal Abidin	Prof Dr Wang Yin Chai	Wind Energy Potential Modeling In Sarawak For Rural Electrification
Sylvia Ong Ai Ling	PhD	Full Time	Dr Hushairi Bin Zen	Prof Dr Wan Hashim Wan Ibrahim	Network For Smart Traffic Management: Topology, Architecture And Protocol
Teh Chin Ying	PhD	Full Time	Dr Tay Kai Meng	-	Development Of A Local Monotonicity Preserving Data-Driven Fuzzy System For Video Signal Processing
Kelvin Yong Hong Chien	Master	Part Time	AP Dr Wan Azlan Wan Zainal Abidin	Dr Nordiana Rajaei / En Norhuzaimin Julai	Raspberry Pi Based Energy Efficient Lighting Control with Smart Energy Monitoring

Mechanical and Manufacturing Engineering

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Cheong Yaw Hong	Master	Part Time	Prof Ir Dr Andrew Ragai Henry Rigit	-	Harnessing Tidal Energy for Electricity Generation at Sejingkat, Kuching, Sarawak
Syed salman shafqat	PhD	Full Time	Prof. Dr Amir Azam Khan	Dr Shani Faridah Salih / Dr Nicholas Kuan Hoo Tien	Synthesis and characterization of Cu & Ni embedded ORMOCERS by sol-gel method
Houssein M.A Elawad	PhD	Full Time	AP Dr M. Shahidul Islam	AP Dr Syed Tarmizi Syed Shazali / AP Dr Abdullah Yassin	Measuring Contextual Effect of Inputs on Physical and Economic Efficiency of Production
Tracy anak Dickie	PhD	Part Time	AP Dr Syed Tarmizi Syed Shazali	Ir Dr Mohd. Shahril bin Osman	Fabrication and Mechanical Measurement of Nipah Palm Fiber Material
Teo Chong Yaw	Master	Full Time	Dr Abdullah bin Haji Yassin	-	Temperature Measurement of High Speed Milling
Kamran Ahmed Samo	PhD	Full Time	Prof Ir Dr Andrew Ragai Henry Rigit	AP Dr Azhaili Baharun / Prof Madya Dr Jane Labadin (FIT) / Dr Thelaha Masri	Determination and Mapping of Tidal Electrical Power Potential for Sarawak and Sabah
Christopher Jantai anak Boniface	Master	Full Time	Dr Mohd Danial Bin Ibrahim	-	A Radiant Times Series Method for Cooling Load Calculation for Dewan Tunku Abdul Rahman (DeTAR PUTRA UNIMAS)
Elammaran Jayamani	PhD	Part Time	Prof Dr Sinin Hamdan	Dr Abu Saleh Ahmed / Prof Madya Dr Saad A. Mutasher (Swinburne)	Absorption and Impedance Measurements of Lignocellulosic Particle Composite for Sound Absorbing Wooden Construction Materials
Taharah binti Edin	Master	Full Time	Dr Abu Saleh Ahmed	Dr Md Rezaur Rahman	Biodiesel Production from Jatropha Oil as an Alternative Fuel for Diesel Engine
Md Faruk Hossen	PhD	Full Time	Prof Dr Sinin Hamdan	Dr Md Rezaur Rahman	Crystal Structures and Growth Mechanisms of Nanoparticles Prepared by Polyol Method with Different Couples of Metal

Noor Ain binti Rozaini	PhD	Full Time	Dr Abdullah Yassin	AP Dr M. Shahidul Islam & AP Dr Syed Tarmizi Syed Shazali	A Novel Method to Monitor Cutting Edge Temperature in High Speed Machining
Wan Farhana binti Mohamad	PhD	Full Time	Prof Dr Amir Azam Khan	AP Dr Abdullah Yassin & AP Dr Faiz Ahmad (UTP)	Study of Wear and Oxidation of Metal Matrix Composites Containing Solid Lubricants Produced by Powder Metallurgy Method
Muhammad Ridhwan bin Abdul Rahman	Master	Full Time	Dr Syed Tarmizi Syed Shazali	AP Ir Dr Mohamad Shahril Osman / AP Dr M. Shahidul Islam	Design of an Internal Thermal Heat Exchanger Concept System for a Concentrated Solar Power Tube
Nadia anak Austin	Master	Full Time	Dr Mohd Danial Ibrahim	Dr Azham Zulkharnain (FSTS)	Evaluation of Sago Biomass Based Composite Material for 3D Printing Technology
Siti Zaharah binti Mohd Ibrahim	Master	Part Time	Dr Mohd Danial Ibrahim	Muhd Fadzli Ashari	Macro Surface Modification for Airplane Winglets Based on Dimples and Rivets Protuberances
Tay Chen Chiang	PhD	Full Time	Prof Dr Sinin Hamdan	-	The Mechanical Properties of Natural Fiber (Sago Residues) Reinforced Urea Formaldehyde Resin Composite
Liew Fui Kiew	PhD	Full Time	Prof Dr Sinin Hamdan	Dr Md Rezaur Rahman / Prof Ir Dr Mohamad Rusop Mahmood (UiTM Shah Alam)	Physico-Mechanical Properties of Tin Oxide Nanoparticles Modified Jute-Bamboo Fiber Composites
Josephine Lai Chang Hui	PhD	Full Time	Dr Md Rezaur Rahman	Prof Dr Sinin Hamdan	Polymer Nanotechnology for Biomedical Application
Md Mizanur Rahman	Master	Full Time	Prof Dr Sinin Hamdan	Dr Md Rezaur Rahman	Development of Novel Biocomposition and Their Hybrid Composites with Nanosilica
Nurulhuda binti Nadziri	Master	Full Time	Dr Idawati Ismail	Prof Dr Sinin Hamdan	Microstructural Characterization of Cementless Binders Using Industrial By-Products for Construction Materials
Asliana Binti Asmara	Master	Part Time	Dr Mohd Danial Bin Ibrahim	Dr Nabilah Ibrahim	Investigation Of Multiphase Oceanic Laminar-Turbulent Flow For Modified Designs Tidal Turbine Blades Surface
Dayang Salyani Binti Abang Mahmod	PhD	Full Time	Prof. Dr Amir Azam Khan	Dr Magdalene Andrew Munot, Prof. Jean Claude Labbe (Limoges), Dr Nicolas Glandut (Limoges)	Laser Oxidation Of Porous Non-Oxide Zrb ₂ -SiC And TiB ₂ -SiC Composites For Low Temperature Protonic Ceramic Fuel Cells (Ltpcfcs)
Hafiza Binti Ramji	Master	Full Time	AP Dr Syed Tarmizi Bin Syed Shazali	Dr. Saiful Bahari Mohd Yusoff	Turbine Frame Design For Sustainable Instream Horizontal Micro Hydro Turbine Generator
Hazel Maybelline Anak Johan	Master	Full Time	AP Dr Syed Tarmizi Bin Syed Shazali	AP Dr Abdullah Haji Yassin	Effects Of Automated Manufacturing System Toward Workforce'S Behaviours
Jie Xu	PhD	Full Time	Dr Nicholas Kuan Hoo Tien	Prof Dr Amir Azam Khan	Natural Fibre Reinforced Biodegradable Composites
Joel Ting Sing Hong	Master	Full Time	Dr. Md. Rezaur Rahman	Prof. Dr Sinin Hamdan	Preparation And Characterization Of Chemically Modified Cellulose Gel-Reinforced Unsaturated Polyester Composites
Kho Liew Ching	Master	Full Time	Dr Nicholas Kuan Hoo Tien	Encik Mohd Syahmi Jamaluddin	Fabrication Of Chitosan/Pla Blend Reinforced Natural Fibre Composite And Its Properties
Kiew Kwong Siong	PhD	Full Time	Prof. Dr Sinin Hamdan	AP Dr Hasnizam Abdul Wahid	Sound Quality Assessment And Acoustic Properties Of Selected Wood Species In Malaysia

Lee Meng Chuen	Master	Full Time	Dr Nicholas Kuan Hoo Tien	Puan Marini Sawawi	Characterisation Of Chemical Treatments Of Pandanus Fibre In Composites
Mohamad Ismail Bin Mohamad Salim	Master	Full Time	AP Dr Abu Saleh Ahmed	Prof. Dr Sinin Hamdan	Efficient Conversion Of Castor Oil To Biodiesel By Using Heterogeneous Catalyst
Nurhanna Zulaikha Binti Ishak	Master	Full Time	Dr Shahrol Bin Mohamaddan		Analysis Of Ergonomics Approach To Accessibility And Needs Of Children With Disability In Public Facilities And Consumer Products
Tan Ming Yee	Master	Full Time	Dr Nicholas Kuan Hoo Tien	Prof Dr Amir Azam Khan	Characterization Of Ground Coffee Waste-Based Bio-Composite
Ting Ching Hung	Master	Full Time	AP Dr M. Shahidul Islam		
Yiong Ngee Fei	Master	Full Time	Prof. Dr Amir Azam Khan	Dr Nicholas Kuan Hoo Tien	The Effect Of Particle / Fibre Addition To Polymer Matrix Composites : Study Of Vibration And Acoustic Properties
Mohamad Ismail bin Mohamad Salim	Master	Full Time	AP Dr Abu Saleh Ahmed	Prof Dr Sinin Hamdan / Dr Md Rezaur Rahman	Efficient Conversion of Castor Oil to Biodiesel by Using Heterogeneous Catalyst
Ahmad Syafiq Haqim bin Sarip	Master	Full Time	Dr Syed Tarmizi Syed Shazali	AP Dr Mohamad Shahril Osman / Prof Madya Dr M. Shahidul Islam	Design of Tracking Parabolic Solar Trough for Diffused Sun Radiation
Devaraj a/l Shanmugam	Master	Full Time	Dr Abdullah Yassin		Developing Cutting Edge Temperature Measurement of End Mill Tool in High Speed Machining Using Infrared Radiation
Lee Man Djun	PhD	Full Time	AP Dr M. Shahidul Islam	AP Dr Syed Tarmizi Syed Shazali / Dr Abdullah Yassin	Modeling on Capacity Utilization of Manufacturing Industry in Malaysia

Chemical Engineering and Energy Sustainability

Name	Level	Type	Supervisor	Co-Supervisor	Title
Nazeri Abd Rahman	PhD	Part Time	Dr Rubiyah binti Haji Baina	Prof Dr Haji Mohd. Omar bin Abdullah	Sustainable Utilisation of Pelletised Plantation Biomass Wastes in Sarawak for Power Generation
Tee Pei Fang	PhD	Full Time	Prof Dr Mohammad Omar Abdullah	Dr Ivy Tan Ai Wei	A Combined Microbial Fuel Cell and Adsorption System for Bioenergy Production and Wastewater Treatment
Afrasyab Khan	PhD	Full Time	AP Dr Khairuddin Sanaullah	Dr Hushairi Haji Zen, Dr Lim Soh Fong	Super-Sonic Gases Direct Contact Mixing and Condensation Study
Deviana Endia Pani	Master	Full Time	Dr Shanti Faridah Salleh	AP Dr Khairuddin Sanaullah / Dr Lim Soh Fong	Study on Hydrogen Sulphide (H ₂ S) in Bakun Embankment Dam
Sherena binti Saree	Master	Full Time	Dr Shanti Faridah Salleh	Prof Dr Mohammad Omar Abdullah	Fundamental Studies on the Thresher Performance in the Palm Oil Mill
Ephrem Ryan anak Alphonsus	Master	Part Time	Prof Dr Mohammad Omar Abdullah	Dr Leo Sing Lim (ICATS)	Fluid Diversion System for Automobile Adsorption Air Conditioning System
Wong Teck Soon	PhD	Full Time	Dr Shanti Faridah Salleh	Dr Lim Soh Fong	Assessment of the Availability of Agricultural Waste for Energy Production

Siti Kartina Abdul Karim	PhD	Full Time	Dr Lim Soh Fong	Prof Ir Dr Law Puong Ling / Dr Shanti Faridah Salleh	Green Materials for Water Treatment Process
Kam Yat Sen	Master	Part Time	Dr Lim Soh Fong	Dr Tay Kai Meng	Analysis of Diffusion Models for Calcium Alginate Encapsulated Magnetic Sorbent
Jong Yik Jia	Master	Full Time	Prof Dr Haji Mohd. Omar Bin Abdullah	-	Energy Performance Study of A Chip Fryer
Agnes Lee Yung Weng	Master	Full Time	Dr Lim Soh Fong	-	Selective Heavy Metals Removal By Zirconium Based Magnetic Sorbent
Jacqueline Mitchell Varonica Anak Ratai	Master	Part Time	Dr Shanti Faridah Bte Salleh	Encik Mohd Farid Atan	Study On Catalytic Pyrolysis Of Macroalgae For Production Of Bio-Oil
Mohamad Zulfika Hazielim B Zakaria	Master	Part Time	Dr Rubiyah Bt Hj Baini	Puan Nur Syuhada Binti Ahmad Zauzi	Study On The Chemical Treatment Of Red Mud As Catalyst For The Conversion Of Plastic Waste To Fuel
Tan Yie Hua	PhD	Full Time	Prof Dr Mohammad Omar Abdullah	AP Dr Cirilo Nolasco Hipolito	Biodiesel Production From Waste Oil, Chemical Characterization And Effect Of Biodiesel-H ₂ O Emulsion On A Small Portable Diesel Generator System
Tian Chuan Min	Master	Full Time	Prof Dr Mohammad Omar Abdullah	AP Dr. Abu Salleh Ahmed	Custom Design, Development & Techno-Economical Study Of A Small Cooling Water Power Generator For Sejingkat Power Corporate Sdn Bhd
Wong Teck Soon	Master	Full Time	Dr Shanti Faridah Bte Salleh	Dr Lim Soh Fong	Acid Hydrolysis Of Sago Hampas Using Different Types Of Reactors For Glucose Production

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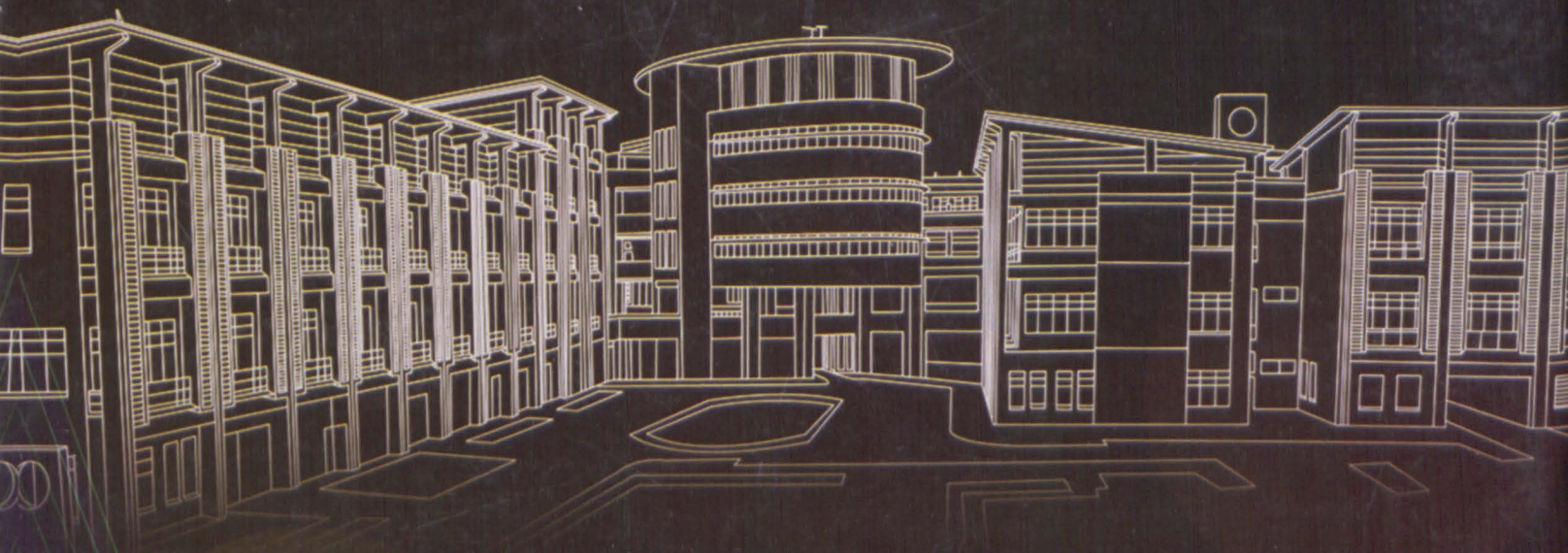
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